

K4
11/2:674
C.2



*North Carolina Department of Transportation
Statewide Planning Branch
Small Urban Planning Unit*

THOROUGHFARE PLAN

Technical Report For

Graham County And Robbinsville



N.C. DOCUMENTS
CLEARINGHOUSE

FEB 2 1999

November, 1998

STATE LIBRARY NORTH CAROLINA
RA 211.1

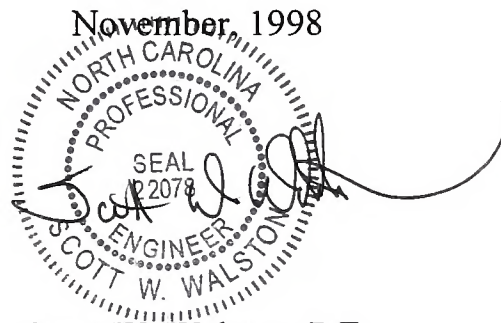
Graham County Thoroughfare Plan Technical Report including Robbinsville

Prepared by the:

Statewide Planning Branch
Division of Highways
North Carolina Department of Transportation

In Cooperation with:

Graham County
Town of Robbinsville
The Federal Highway Administration
U.S. Department of Transportation




Scott W. Walston, P.E.
Small Urban Unit Project Engineer

Acknowledgements

Persons responsible for this report:

Transportation Planning Engineer:	Scott W. Walston, P.E.
Small Urban Planning Unit Head:	W.O. Stafford, P.E.
Manager, Statewide Planning Branch:	M.R. Poole, Ph.D., P.E.
Engineering Technician:	Jonah Uduagbomen



Digitized by the Internet Archive
in 2011 with funding from
State Library of North Carolina

Table of Contents

Chapter 1 - Introduction	1
Overview	1
Background	1
Highlights	2
Chapter 2 - Recommended Thoroughfare Plan	9
Intent of the Thoroughfare Plan	9
Thoroughfare Plan Recommendations	9
<i>US 74 Relocation</i>	10
<i>US 129 Widening</i>	11
<i>US 28 Upgrading</i>	13
<i>US 143 Relocation</i>	14
<i>Atoah Street Extension</i>	15
<i>Widening Projects</i>	16
<i>Intersection Improvements</i>	17
Public Involvement	17
Chapter 3 - Implementation of the Thoroughfare Plan	23
County Adoption of the Graham County	
Thoroughfare Plan	23
Municipal Adoption of the Robbinsville	
Thoroughfare Plan	23
Subdivision Controls	23
Land Use Controls	24
Development Reviews	24

Funding Sources	24
<i>Capitol Improvements Program</i>	24
<i>Transportation Improvement Program</i>	24
<i>Industrial Access Funds</i>	25
<i>Small Urban Funds</i>	25
The North Carolina Highway Trust Fund Law	25
Implementation Recommendations	25
Construction Priorities and Cost Estimates	26
 Chapter 4 - Analysis of Graham County's Roadway System	 29
Current Transportation Plans for Graham County and Robbinsville	29
<i>Thoroughfare Plans</i>	29
<i>Transportation Improvement Program Projects</i>	29
Existing Travel Patterns and Deficiencies	30
<i>Traffic Demand</i>	30
<i>Width and Alignment Deficiencies</i>	30
<i>Capacity Analysis of the Existing System</i>	33
<i>Traffic Accidents</i>	37
<i>Existing Bridge Conditions</i>	38
Factors Affecting the Future Roadway System	39
<i>Population</i>	40
<i>Economy and Employment</i>	41
<i>Land Use</i>	41
Forecasted Travel Patterns and Deficiencies	42
<i>Future Travel Demand</i>	42
<i>2025 Traffic Capacity Analysis</i>	42
<i>No Build Alternative</i>	43
Consideration of Environmental Factors	49
<i>Wetlands</i>	49
<i>Threatened and Endangered Species</i>	49
<i>Historic Sites</i>	50

Appendix A - Thoroughfare Planning Principles	53
Benefits of Thoroughfare Planning	53
County Thoroughfare Planning Concepts	53
Thoroughfare Classification Systems	53
Urban Classification	54
<i>Major Thoroughfares</i>	54
<i>Minor Thoroughfares</i>	54
<i>Local Access Streets</i>	54
Idealized Major Thoroughfare System	54
Rural Classification	55
<i>Rural Principal Arterial System</i>	55
<i>Rural Minor Arterial System</i>	55
<i>Rural Collector Road System</i>	55
<i>Rural Local Road System</i>	55
Objectives of Thoroughfare Planning	56
Operational Efficiency	57
System Efficiency	58
Application of Thoroughfare Planning Principles	58
 Appendix B - Thoroughfare Street Tabulation and Recommendations	 65
Appendix C - Typical Cross Sections	73
Appendix D - Recommended Subdivision Ordinances	81
Definitions	81
Design Standards	83

List of Tables

Table 1

Funding Sources and Methods Recommended for Implementation of Projects	26
---	----

Table 2

Probability Estimation Guide	26
------------------------------	----

Table 3

Benefits Evaluation for Major Projects	27
--	----

Table 4

Potential Cost Estimates for Major Projects	28
---	----

Table 5

Minimum Tolerable Lane Widths	30
-------------------------------	----

Table 6

Locations with 5 or More Accidents in a 3-Year Period	37
---	----

Table 7

Functionally Obsolete Bridges in Graham County	39
--	----

Table 8

Seven Most Structurally Deficient Bridges in Graham County	39
---	----

Table 9

Population Trends and Projections	40
-----------------------------------	----

Table D-1

Minimum Right-of-Way Requirements	84
-----------------------------------	----

Table D-2	
Design Speeds (Metric)	86
Table D-3	
Design Speeds (English)	86
Table D-4	
Sight Distance (Metric)	87
Table D-5	
Sight Distance (English)	87
Table D-6	
Superelevation Table (Metric)	88
Table D-7	
Superelevation Table (English)	88
Table D-8	
Maximum Vertical Grade (Metric)	89
Table D-9	
Maximum Vertical Grade (English)	90

List of Figures

Figure 1	
Location Map	3
Figure 2	
Graham County Adopted Thoroughfare Plan	5
Figure 3	
Robbinsville Adopted Thoroughfare Plan	7
Figure 4	
Graham County Recommended Improvements	19
Figure 5	
Robbinsville Recommended Improvements	21
Figure 6	
1996 Average Daily Traffic and Capacities	31
Figure 7	
Levels of Service	35
Figure 8	
2025 Average Daily Traffic and Capacities	45
Figure 9	
Existing and Projected Traffic Volumes for Robbinsville	47
Figure A-1	
Idealized Thoroughfare Plan	59

Figure A-2

Rural Highway Network Functional Classification	61
---	----

Figure A-3

Graham County Functional Classification	63
---	----

Figure C-1

Typical Cross Sections	77
------------------------	----

Chapter 1

INTRODUCTION

Overview

Officials of Graham County, prompted by a desire to adequately plan for the future transportation needs of Graham County, requested the North Carolina Department of Transportation's (NCDOT) assistance in conducting a thoroughfare plan study. In April, 1994 a representative from the Statewide Planning Branch met with local officials to determine the Transportation needs of the area. The main concern from officials was access to the County.

In 1997, the Town of Robbinsville desired a local project that could not be designated on the County Study (Atoah Street Extension). A Robbinsville Thoroughfare Plan was then developed, separate from the County Thoroughfare Plan. Therefore, two separate plans were developed, one each for Graham County and the Town of Robbinsville. This report combines the discussion of these studies, since several of the recommendations are common to both thoroughfare plans

This primary purpose of this report is to document the findings and recommendations of the thoroughfare plan studies conducted for Graham County and Robbinsville. The secondary purpose of this report is to document the basic thoroughfare planning principles and procedures used in developing these recommendations. This report can be divided into three parts. The first part of the report, covered in Chapter 1, reviews the highlights of the study. Chapters 2 and 3 provide a detailed description of the Thoroughfare Plan study recommendations and address different methods by which these recommendations can be implemented. The final chapter, Chapter 4, covers study procedure and findings.

Information that will be especially useful to the practitioner is provided in the Appendix. The principles of thoroughfare planning are covered in Appendix A, a detailed tabulation of all routes on the Thoroughfare Plan and a graphical representation of typical cross sections can be found in Appendix B and Appendix C respectfully. The information related to subdivision ordinances is covered in Appendix D.

Background

Graham County is located in the southwestern portion of North Carolina. The county is bounded on the north and east by Swain County, on the west by Tennessee, and on the south by Cherokee and Macon Counties. The geographical location of Graham County and Robbinsville is shown in Figure 1. The topography of the area is mountainous.

Due to the mountainous terrain and rural nature of the county, there are five paved entrances into Graham County, two crossings each of US 129 and NC 28, and NC 143. During a rainstorm in early 1994, several slides caused the closing of two of the then three major entrances into Robbinsville, the largest of two incorporated communities in the county. The county is also lacking a four lane facility, but intrastate US 74 Relocation (TIP Project A-9) is proposed to fulfill this need.

Graham County has one of the state's lowest household incomes and one of the highest unemployment rates (News and Observer, Feb. 13, 1995). Approximately 35% of the workforce are in manufacturing, and 3% in agriculture. No airports, hospitals, or community colleges, or bus service are located anywhere in the county. However, with the recent opening of the Cherohala Skyway (NC 143) from Robbinsville to Tennessee, Graham County expects an increase in tourism.

Highlights

Major highlights of the 1997 Graham County and 1997 Town of Robbinsville Thoroughfare Plans are outlined below. The Thoroughfare Plan map for Graham County is shown in Figure 2, and Robbinsville in Figure 3. Projects included in the 1998-2004 Transportation Improvement Program (TIP) are shown in parenthesis. Projects not listed below are minor or maintenance related (widening) and are also discussed in Chapter 2. The main projects discussed in Chapter 2 of this report are:

- 1) Relocate US 74 as a four lane divided facility on new and existing location in Graham County to improve access and spur economic development in Graham County. (A-9)
- 2) Widen the sections of US 129 between NC 143 (Massey Branch Road) and the southern corporate limits of Robbinsville from 6.7 m (22 ft) to 7.3 m (24 ft) with turn lanes at major intersections, and widen from three to five lanes inside Robbinsville.
- 3) Widen and upgrade NC 28 from Fontana Village to Stecoah. (R-2407)
- 4) Widen, upgrade, and realign NC 143 west of Robbinsville to provide better access to the Cherohala Skyway (R-2822)

The North Carolina Department of Transportation and the Town of Robbinsville are jointly responsible for the proposed thoroughfare plan improvements. Cooperation between the state and the local governments is of primary concern. The Robbinsville Thoroughfare Plan has been mutually adopted by all parties and it is the responsibility of the local government to implement the plan following the guidelines set forth in Chapter 3.

The Graham County Thoroughfare Plan has not been adopted by the County Commissioners.

It should be emphasized that the recommended plan is based on anticipated growth of the county as indicated by current trends. Prior to construction of specific projects, a more detailed study will be required to reconsider development trends and to determine specific locations and design requirements.

GEOGRAPHIC LOCATION MAP FOR GRAHAM COUNTY

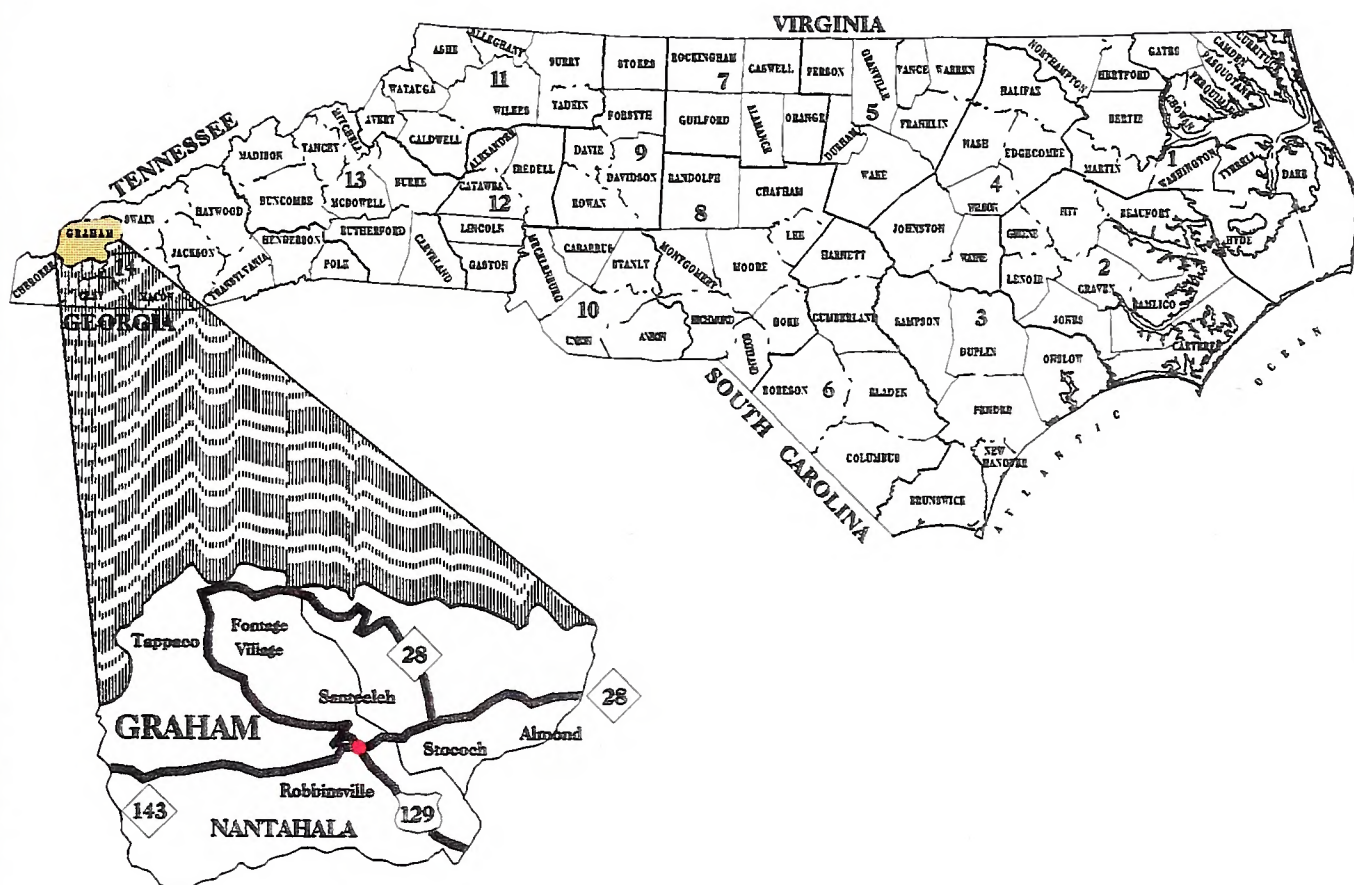


FIGURE 1

RECOMMENDED THOROUGHFARE PLAN

LEGEND

	EXISTING	PROPOSED
INTERSTATE		
PRINCIPAL ARTERIAL		
MINOR ARTERIAL		
MAJOR COLLECTOR		
MINOR COLLECTOR		
MAJOR THOROUGHFARE		
PLANNING AREA BOUNDARY	—————	—————

ADOPTED BY:

GRAHAM COUNTY

PUBLIC HEARINGS

RECOMMENDED BY:
STATEWIDE PLANNING

N.C. DEPARTMENT OF
TRANSPORTATION

JUNE 25, 1997

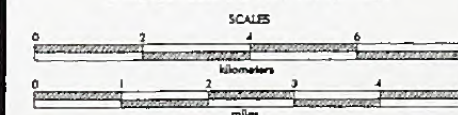
FIGURE 2



GRAHAM COUNTY NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION



June 25, 1997

THOROUGHFARE PLAN

LEGEND

	Existing	Proposed
MAJOR		
MINOR		
CORPORATE LIMITS		

ADOPTED BY:

TOWN OF ROBBINSVILLE

August 7, 1997

PUBLIC HEARINGS

November 7, 1996

RECOMMENDED BY:

STATEWIDE PLANNING

September 15, 1997

N.C. DEPARTMENT OF
TRANSPORTATION

November 7, 1997

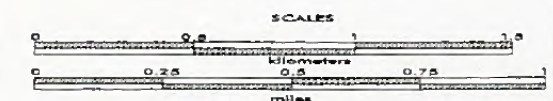
FIGURE 3



ROBBINSVILLE NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION



Chapter 2

RECOMMENDED THOROUGHFARE PLANS

Intent of the Thoroughfare Plan

Transportation is the backbone of a region's economic vitality. Without an adequate transportation system people cannot easily reach their intended destination, goods cannot be delivered to market in a cost effective manner, and investors may look to invest in better served areas. Recent trends such as regional economies, "just in time" delivery, increased automobile ownership, and increased migration away from the central cities and towns are taxing our existing transportation system and requiring that we put more emphasis on planning for our transportation future.

A thoroughfare plan study uncovers the need for new facilities and at the same time identifies existing and future deficiencies in the transportation system. A thoroughfare plan also provides a representation of the existing highway system by functional use. This use can be characterized as part of the arterial street system, the collector street system, or the local street system.

This chapter presents the thoroughfare plan recommendations. It is the goal of these studies that the recommended plan set forth a transportation system that will serve the anticipated traffic and land development needs for Graham County and Robbinsville. The primary objective of this plan is to reduce congestion and improve safety by eliminating both existing and projected deficiencies in the thoroughfare system.

Graham County is very isolated in terms of access. There are only five paved entrances into the county. Any improvement of access and internal facilities would allow for increased job opportunities and industrial expansion. Also, small wholesale and retail business would find their shipping costs reduced by shorter travel lengths and travel times from suppliers.

Thoroughfare Plan Recommendations

The process of developing, testing and evaluating alternate plans involved several considerations. These included the goals and objectives of the area, identified deficiencies (see Chapter 4), environmental impacts, existing and anticipated land development, and travel services. Aerial photography, topographic mapping, field inspection and discussion with local staff, officials, and interested local citizens provided additional basis for identifying and evaluating recommendations of the Graham County and Robbinsville Thoroughfare Plans. Purpose and need statements, along with detailed descriptions of the recommended improvements for Graham County and Robbinsville is given below and shown in Figures 4 and 5.

US 74 Relocation - Purpose and Need

- **Project recommendation:** It is recommended that US 74 be relocated on a four lane divided highway on mostly new location in Graham County to promote economic growth and development in the Appalachian region. The Graham County portion of this project will extend from near the Southern NC 28/Swain County Line, run east and south of Robbinsville, and connect to Cherokee County near SR 1110 (Long Creek Road). The project limits for the entire project are from US 19/74/NC 28 intersection in Swain County to US 19/74/129 in Andrews. Part of this facility is under construction, with an estimated cost of \$341,408,000 (according to the 1998-2004 TIP) for the entire facility. This project is part of the Appalachian Development Highway System, which was passed by Congress in 1965 to promote economic growth and development in the Appalachian region.
- **Transportation Demand:** The construction of this project is needed to provide better highway transportation for Graham County that is served principally by two roads - US 129 and NC 28. Both are two lane facilities with many steep grades and curves. This facility would allow easier access to jobs, medical facilities, and educational facilities outside Graham County. Much of this project is in the environmental impact stage, with a recommended alignment not finalized. The AADT (Average Annual Daily Traffic) on this project is expected to be between 3,600 and 6,000, with the higher volumes coming on the sections that allow access to adjacent land use. The sections that are currently planned to allow driveways are the existing sections of NC 28 and NC 143 which are incorporated into this project.
- **Capacity:** Currently, to get from Andrews to Bryson City, motorists must now follow two lane US 19-74 through Nantahala Gorge. In the summer, cars and buses transporting rafters to the Nantahala River cause US 19-74 to exceed capacity. When the US 74 Relocation project is complete, the Level of Service on the new facility is expected to be A. The ADT (Average Daily Traffic) for the new facility is expected to be 3,600-6,000 vpd (vehicles per day) by the year 2025.

The widening of the existing US 74 will not meet the goals of the Appalachian Development System, or improve access to Graham County. The existing US 19-74, which is not located in Graham County, gives access to adjacent land development, which conflicts with the higher speeds of long distance drivers. The stopping, starting, and turning movements of area business and housing, all contribute to more dangerous driving conditions. It can be safely assumed that through traffic will use the US 74 relocation instead of the existing facility. Therefore, the US 74 Relocation is the only reasonable alternative for improving some of the transportation deficiencies in Graham County, and the existing corridor. US 74 Relocation will help reduce the demand on some sections US 129, NC 143 and NC 28.

- **Safety Issues:** If the US 74 Relocation is not constructed, tremendous congestion and delays will result on existing US 19/74, especially during the summer tourist season. This congestion will result in increased air pollution due to the stop-start conditions along the roadway, as well as increased accidents due to the high numbers and close proximity of vehicles in the traffic stream. The construction of this project is also needed to provide better highway transportation for Graham County that is served principally by two roads - US 129 and NC 28. Both are two lane facilities with many steep grades and curves.
- **Social Demands/Economic Development:** The US 74 Relocation project is expected to have a huge positive economic impact in the county. It will offer easier access to jobs, medical facilities, and educational facilities outside Graham County and to provide more efficient transportation for raw materials and finished goods to and from manufacturers in Graham County. This project was intended to spur economic development in this area. This economic development will also increase the tax base, which in turn means improved public services, which can induce other industries to locate in the county.
- **System Linkage:** This facility, when complete, will link Graham County, Murphy, Andrews, Bryson City, and Sylva to the Asheville area and Georgia. There are no other existing facilities that would adequately link these areas. US 74 Relocation is part of the North Carolina Intrastate System, which is the backbone of the highway system in North Carolina. This route will be important on a statewide and national basis.
- **Relationship to Other Plans:** This project is included in both the Graham County and Robbinsville Thoroughfare Plans. US 74 Relocation is located in three counties: Graham, Cherokee, and Swain County. The Cherokee County Thoroughfare Plan is currently being developed, but has not yet been adopted. There has been coordination with the Cherokee County Thoroughfare Plan. Swain County does not have a mutually adopted Thoroughfare Plan. The US 74 Relocation is an Intrastate System Project, and on the Appalachian Development Highway System. This project is on the NCDOT's Transportation Improvement Program (Project A-9). This proposed project is considered a minor arterial on the Functional Classification System.

US 129 - Purpose and Need

- **Project Description:** It is recommended that US 129 be widened from 6.7 m (22 ft) to 7.3 m (24 ft) with turn lanes at major intersections from NC 143 (Massey Branch Road) to the northern corporate limits of Robbinsville. It is also recommended to widen the 3 lane section inside Robbinsville to 5 lanes. This widening is intended to improve safety and capacity of the existing roadway. The estimated cost of these projects is \$4,596,000.

- **Transportation Demand:** Due to increasing development, both residential and commercial, that is occurring on or near this corridor, traffic volumes on this route are also increasing. Annual average daily traffic (AADT) volumes in 1995 ranged from 440 vpd (vehicles per day) near Topoco (in northern Graham County) to 9,600 inside Robbinsville. The recommended section to be improved has a 1995 AADT between 3,300 to 9,600, and a projected AADT of 6,000 to 18,700 in 2025.
- **Capacity:** The anticipated daily traffic in the design year exceeds the estimated capacity of the roadway, which is 5,200 vpd for the two lane sections, and 14,000 vpd for the three lane section inside of Robbinsville. Major congestion may occur during peak tourist seasons.
- **Safety Issues:** If US 129 is not widened, congestion and delays will occur during the morning and afternoon peak hours. This congestion will result in increased air pollution due to the stop-start conditions along the roadway, as well as increased accidents due to the high number and close proximity of vehicles in the traffic stream.
- **Social Demands/Economic Development:** US 129 is currently a two lane mostly rural facility, except for the three lane section inside the Town of Robbinsville. This route contains much of the commercial amenities in the county, which are mostly located inside Robbinsville. Prevalent on the corridor are gas stations, a hotel, restaurants, and shopping centers, which cater to the many out-of-town visitors who utilize this route. Because of the development along this route, US 129 is a major north-south “peak hour” commuting route, but also a destination in the “off peak” hours for shoppers and travelers.
- **System Linkage:** US 129 is the primary north-south facility in the county. Its connection to Tennessee and US 19-74 near Macon County connects Graham County commuters to other parts of the state. There are no other existing facilities which could adequately serve the needs presented above. The proposed US 74 Relocation should improve traffic conditions in Robbinsville, as some through traffic will bypass south of town.
- **Relationship to Other Plans:** These projects are aspects of both the Graham County and Robbinsville Thoroughfare Plans. This project was recommended by the Statewide Planning Branch to increase safety and capacity on US 129, and is not currently on the Transportation Improvement Program. US 129 is designated as a major collector on the Functional Classification System, and as a major thoroughfare on the Robbinsville Thoroughfare Plan.

US 28 Upgrading (between Fontana Village and Stecoah) - Purpose and Need

- **Project Description:** It is recommended that US 28 between Fontana Village and Stecoah be upgraded and widened to a modern two-lane 6.7 m (22 ft) cross section. to improve safety and capacity. The estimated cost of this project is \$29,700,000.
- **Transportation Demand:** Due to increasing development, including the tourist traffic from Fontana Village, traffic volumes on this route are increasing. Average annual daily traffic (AADT) on this route in 1995 range from 350 near the Swain County line to 880 near NC 143. These volumes are expected to increase to 1,000-1,400 by the design year because of the construction of the US 74 Relocation and increasing tourist development.
- **Capacity:** The anticipated daily traffic in the design year does not exceed the estimated capacity of the roadway, which is 4,400 - 4,900 vehicles per day.
- **Safety Issues:** This project can be divided into two parts, the section between Lake Cheoah and SR 1245 (Fontana Dam Road) (section A), and SR 1245 to SR 1235 (Edwards Road) near Stecoah (section B). Section A (6.1 km, 3.8 mi) consists of a 6.1 m (20 ft) roadway with 2 foot unpaved shoulders. The horizontal alignment is poor with numerous curves of 20 degrees or greater, with a resulting design speed of 30 km/h (~20 mph). The vertical alignment over the entire section varies from 7% to 12%. Section B (20.2 km, 12.5 mi) consists of a 6.7 m (22 ft) pavement with 0.6-1.2 m (2-4 ft) shoulders. The horizontal and vertical alignment is fair. There are 62 horizontal curves of 10 degrees or greater including twenty-eight 20 degree curves. Approximately 60% of this roadway has a grade between 3% and 8%. The existing roadway (both sections) has many blind curves, and the shoulders are too narrow for disabled vehicles to pull onto in the event of an emergency. According to a 1989 Feasibility Study on this project, accidents on this route that resulted in injuries were due to vehicles running off the road. Wider pavement and shoulders should reduce this type of accident, and improve the safety and driver comfort.
- **Social Demands/Economic Development:** The improved facility is needed to offer easier access to jobs, medical facilities, and educational facilities outside of Graham County, and recreational facilities and resorts inside the County.
- **System Linkage:** US 28 connects the northeastern part of the county with recreational areas such as Fontana Village and Fontana Lake. US 28 also connects Graham County with Swain County and Tennessee. There are no other facilities which could adequately serve these areas.

- **Relationship to Other Plans:** This project is an aspect of only the Graham County Thoroughfare Plan. This project is listed on the 1998-2004 TIP as Project R-2407, as an identified future need. This route is designated minor arterial in the functional classification system.
- **Staging:** Due to the costs involved with widening this long section of highway, it is recommended that this project be divided into sections for construction. This project can be divided into two parts, the section between Lake Cheoah and SR 1245 (Fontana Dam Road) (Section A), and SR 1245 (Fontana Dam Road) to SR 1235 (Edwards Road) near Stecoah (Section B). If a decision is made to stage construct this project, it is recommended that Section A be built first. Section A has a smaller cross section and poor alignment.

US 143 Relocation - Purpose and Need

- **Project Description:** It is recommended that NC 143 between NC 143 (Massey Branch Road) and the Cherohala Skyway be upgraded to a standard 7.3 m (24 ft) cross section with 1.2 m (4 ft) shoulders on existing and new location to improve safety and capacity. This route will also provide a more efficient and shorter route between Robbinsville to the Cherohala Skyway. The estimated cost of this project is \$13,255,000, according to the 1998-2004 TIP.

The existing roadway between NC 143 (Massey Branch Road) and the Cherohala Skyway is to be retained. However, the realignment will reduce the curvature and will require a new bridge over Santeetlah Lake. Due to the rugged terrain, right of way is recommended to vary from the existing 9.1 m (30 ft) to 45.7 m (150 ft). No control of access is proposed.

- **Transportation Demand:** Due to increasing tourist traffic to the Cherohala Skyway, traffic volumes on this route are increasing. The average annual daily traffic volumes (AADT) in 1995 ranged from 650 to 1,200 vpd. However, these counts were taken before the Cherohala Skyway opened in 1996. This project is expected to have an AADT in 2020 of between 4,500 - 5,000 vpd, with the higher volumes being on sections that allow access to existing land use. Daily traffic is expected to be higher during peak tourist season, and lower during off season.
- **Capacity:** The anticipated daily traffic in the design year is not expected to exceed the estimated capacity of the roadway, which is 5,000 vehicles per day. However, this route is expected to be near capacity with an AADT of 4,500 vehicles a day. Capacity deficiencies during peak tourist seasons are possible.

- **Safety Issues:** The section of NC 143 proposed for improvement is a two lane facility with 5.5 - 6.1 m (18 - 20 ft) pavement on an alignment with many steep grades and sharp curves, that is very difficult to drive. This section contains an average of 0.6 m (2 ft) usable shoulders. This roadway is located in a scenic mountainous area, in rugged terrain. The improvement of this facility will improve the safety and capacity of this roadway, and shorten the length of travel. According to the 1992 Feasibility Study on this project, many of the accidents on this route are due to vehicles running off the road. The improvements should decrease these accidents.
- **Social Demands/Economic Development:** The improved facility is needed to offer easier access to the Cherohala Skyway and Robbinsville, and recreational facilities inside the County. The NC 143 Relocation is 4.35 km (2.70 mi) shorter than the existing NC 143 alignment, therefore improving air quality due to shorter trip lengths. This facility will carry local and emergency vehicle traffic, along with through traffic destined to the Cherohala Skyway.
- **System Linkage:** NC 143, in conjunction with NC 143 Business, connects the Cherohala Skyway and Tennessee to Robbinsville, the county's largest municipality. NC 143 is the only way to access the Cherohala Skyway in North Carolina. NC 143 also connects US 129 to the Cherohala Skyway. There are no other facilities which could adequately serve these areas.
- **Relationship to Other Plans:** This project is an aspect of both the Graham County and Robbinsville Thoroughfare Plans. It is listed on the 1998-2004 TIP as Project R-2822, with construction scheduled to begin in 2002. This route is designated rural major collector in the functional classification system.

Atoah Street Extension - Purpose and Need

(see Robbinsville Thoroughfare Plan, Figure 3, page 7)

- **Project Description:** It is recommended that Atoah Street in Robbinsville be extended north to the intersection of SR 1117 (Moose Branch Road). This route will provide a more efficient and shorter route to access the Cherohala Skyway, and Graham County's largest employer, Stanley Furniture. Currently trucks going to this industry must negotiate three ninety degree curves in Robbinsville to reach the furniture plant, which can be disruptive to traffic. The estimated cost of this project is \$574,000.
- **Transportation Demand:** Due to increasing tourist traffic to the Cherohala Skyway, traffic volumes on NC 143 Business in and around Robbinsville are increasing. The average annual daily traffic (AADT) on NC 143 near the Stanley Furniture Company is 1,200 in the year 1995. However, these counts were taken before the Cherohala

Skyway opened in 1996. It is expected that the traffic on NC 143 Business will be over capacity in the design year (2025). This route will help alleviate some of the traffic burden on NC 143 Business.

- **Capacity:** The anticipated daily traffic in the design year of NC 143 Business exceeds the estimated capacity of the roadway, which is 5,600 vehicles per day. This route will help alleviate some of the capacity deficiencies on NC 143 Business, especially slow moving truck traffic.
- **Safety Issues:** The section of NC 143 currently used is a two lane facility with 5.5 - 6.1 m (18-20 ft) pavement on alignments with several sharp curves, and can be very difficult to drive. The relocation of some traffic to Atoah Street Extension will improve the safety and capacity of US 143 Business, and shorten the length of travel for some drivers. It may also help reduce some of the truck traffic in Robbinsville.
- **Social Demands/Economic Development:** The improved facility is needed to offer easier access to the Cherohala Skyway, downtown Robbinsville, and Stanley Furniture. The proposed facility should improve air quality due to decreased congestion.
- **System Linkage:** This facility would connect NC 143 Business near Stanley Furniture with NC 143 Business near downtown Robbinsville. It would provide a shorter route than the existing NC 143 Business.
- **Relationship to Other Plans:** This project is an aspect of the Robbinsville Thoroughfare Plan. This route (along with Atoah Street) is designated a minor thoroughfare in the Robbinsville Thoroughfare Plan. This idea was first proposed by W. Kenneth Clark, the vice president of Stanley Furniture, in a letter dated July 15, 1988. This recommendation is also supported by the Robbinsville Town Council.

Widening Projects

The following routes are proposed to be widened to improve safety and capacity. A particular project's appropriate thoroughfare plan is included in parenthesis.

- NC 143 (Massey Branch Road) - Widen from a two-lane 6.1 m (20 ft) to 6.7 m (22 ft). (Robbinsville Thoroughfare Plan)
- NC 143 Business (Snowbird Road) - Widen from a two lane 5.4 - 6.1 m (18-20 ft) facility to 6 m (22 ft). (Robbinsville Thoroughfare Plan)
- SR 1206 (Old Tallulah Road) - Widen the section between SR 1275 (Five Points Road) and SR 1260 (Airport Road) from a two-lane 4.3 m (14 ft) facility to 5.4 m (18 ft). Widen the section from SR 1260 (Airport Road) to SR 1208 (Linsenbee Road) from 5.4 m (18 ft) to 6.1 m (20 ft). Widen the section from SR 1208 (Linsenbee Road) to US 129 from 5.2 m (17 ft) to 5.4 m (18 ft). (Graham County and

Robbinsville Thoroughfare Plans)

- SR 1242 (Tuskegee Road) - Widen the section from US 129 to SR 1274 (Turpin Road) from 4.9 m (16 ft) to 6.1 m (18 ft). (Graham County Thoroughfare Plan)

Intersection Improvements

The intersection of NC 143 Business (Main Street) with Ford Street is recommended to be realigned with SR 1117 (Moose Branch Road). This realignment will allow for smooth flow. This recommendation is an aspect of the Robbinsville Thoroughfare Plan.

Public Involvement

The Graham County Thoroughfare Plan was officially started on April 17, 1994, by way of a joint meeting with representatives of NCDOT and the Graham County Commissioners. During late 1994 and early 1995, the US 74 Relocation Feasibility Study was in progress. As a result, the thoroughfare plan study was delayed until the feasibility study was complete. Preliminary findings of the thoroughfare plan study were presented to the Graham County Commissioners on June 12, 1995 and September 18, 1995. A joint meeting between Graham County and the Town of Robbinsville was held on November 2, 1995. During these meetings, the idea of a Robbinsville bypass was discussed. (This idea was later dropped and the decision was made to widen the existing US 129 in Robbinsville).

On October 17, 1996, preliminary recommendations were presented to the Graham County Commissioners and the Town of Robbinsville. On November 7, 1996, a public hearing was held. No members of the public attended. During the public hearing, the Town of Robbinsville was concerned about the signage of the area due to the opening of the Cherohala Skyway. These concerns were forwarded to the Division Engineer, and SR 1127 (Snowbird Road) between NC 143 and Robbinsville was later resigned NC 143 Business.

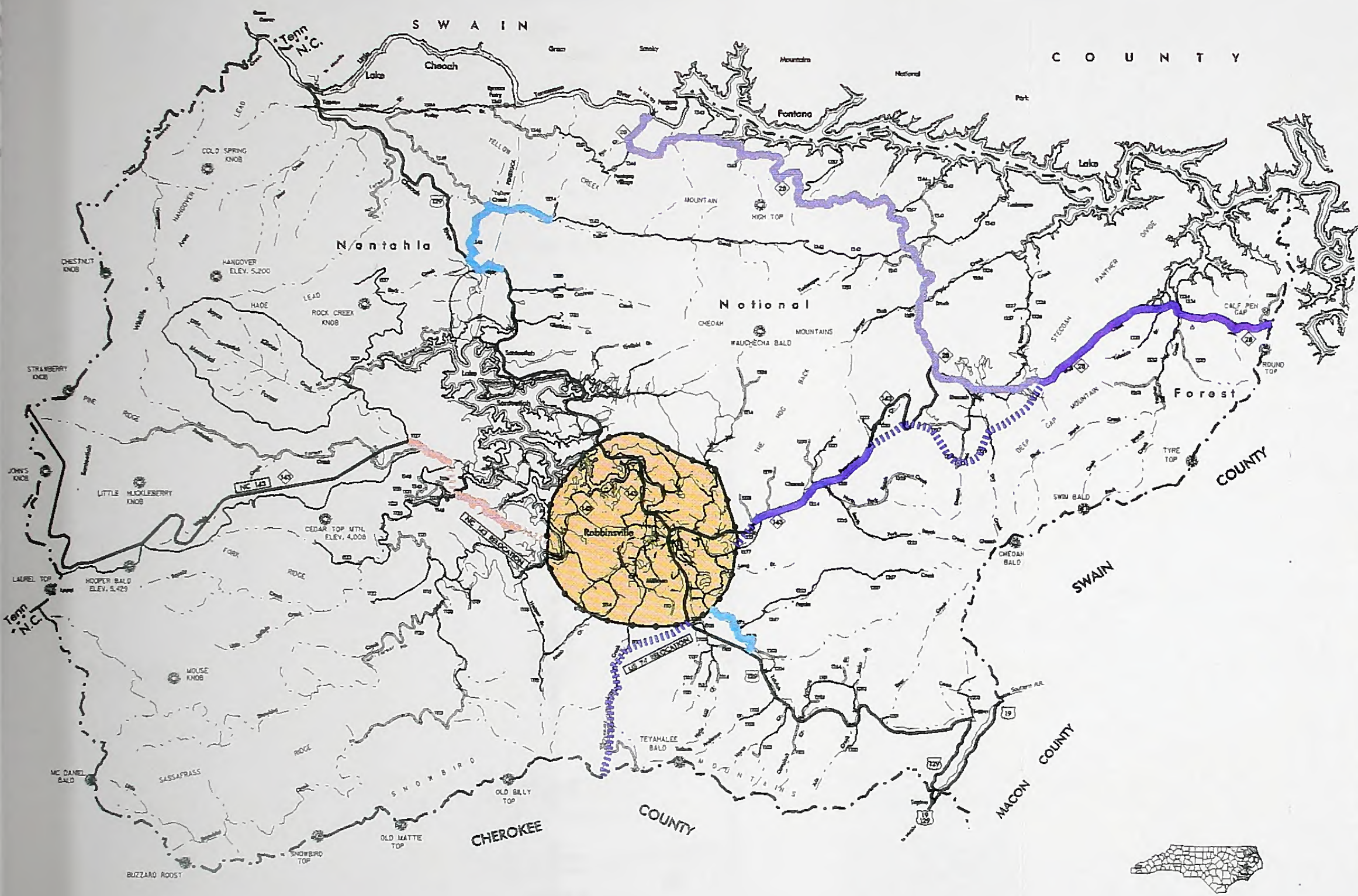
On March 14, 1997, a letter was received by Joel Setzer, P.E., District Engineer, concerning a connector in the Town of Robbinsville. This connector was supported by the Town of Robbinsville, and was later called Atoah Street Extension. However, since Atoah Street Extension was a local project, and could not be designated on the County Plan, a decision was made to have separate thoroughfare plans - one each for Graham County and Robbinsville. The Town of Robbinsville did not feel that Atoah Street Extension would be very controversial since much of its length was along an abandoned railroad corridor, and decided not to hold another public hearing.

The Town of Robbinsville adopted their thoroughfare plan on August 7, 1997. The Town of Robbinsville Thoroughfare Plan was adopted by the Board of Transportation on November 7, 1997.

On March 16, 1998, NCDOT met the Graham County Commissioners since the thoroughfare

plan had not yet been adopted. The commissioners pointed out that US 129 between Robbinsville and SR 1260 (Airport Road) was going to be widened to three lanes, above what was going to be recommended in the thoroughfare plan (at that time the thoroughfare plan recommended widening this section 1.2 m (2 ft) with turn lanes at major intersections). The thoroughfare plan was later adjusted to reflect this project. This project did not alter any of the other thoroughfare plan recommendations.

As of publication date, the thoroughfare plan has not been adopted by the Graham County Commissioners. No reasons have been expressed why this plan has not been adopted.



RECOMMENDED IMPROVEMENTS

LEGEND

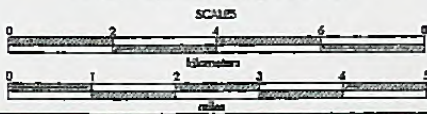
# Of Lanes	Widening	Proposed
2 - 9' LANES		
2 - 12' LANES		
4 LANES DIVIDED		
UPGRADE EXISTING FACILITY		

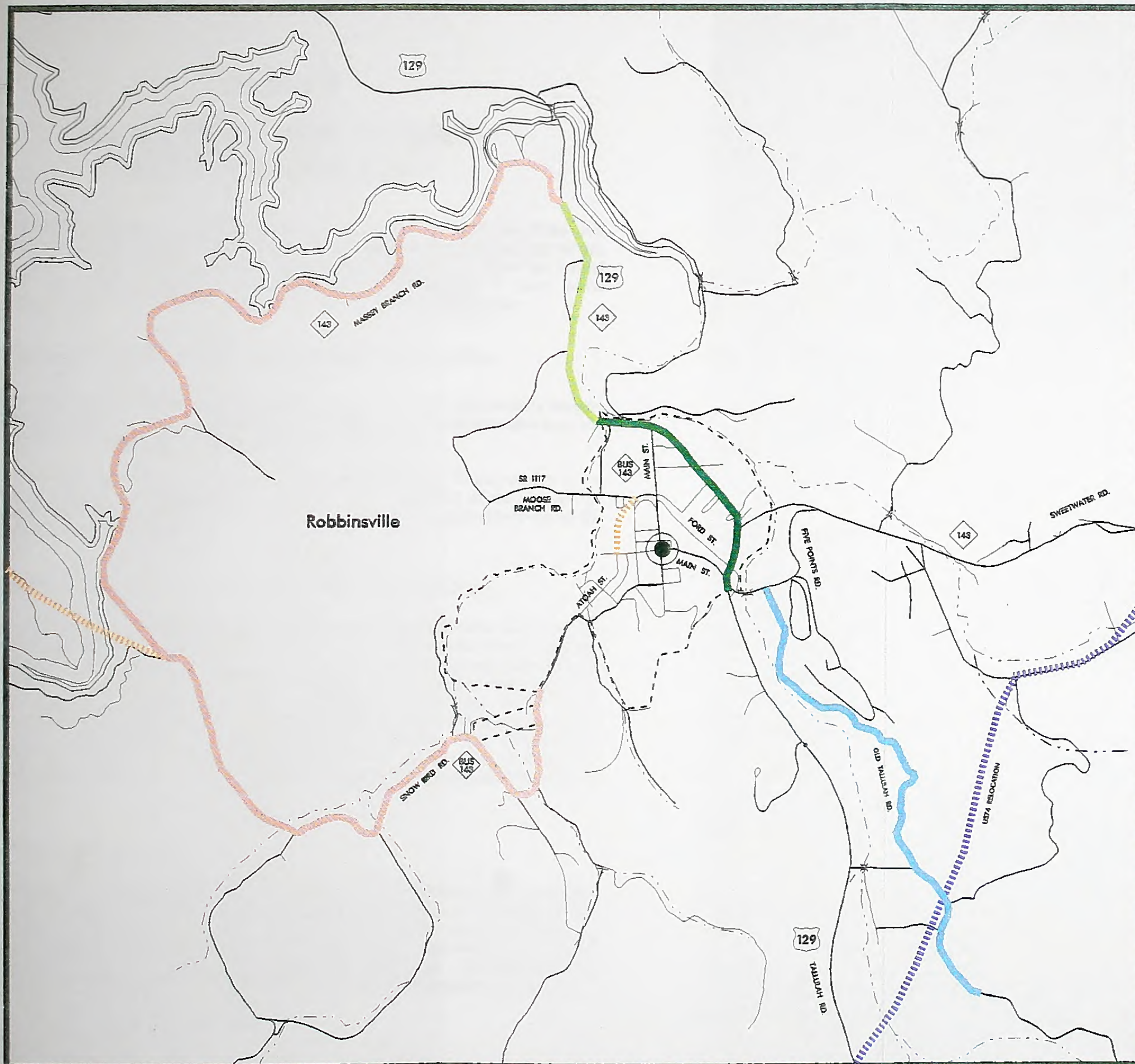
FIGURE 4



GRAHAM COUNTY NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION





RECOMMENDED IMPROVEMENTS

LEGEND

# Of Lanes	Widening	Proposed
2 - 9' LANES		
2 - 11' LANES		
2 - 12' LANES		
2 - 12' LANES W/CENTER TURN LANE @ MAJOR INT.		
4 LANES DIVIDED		
5 - 11' LANES		
UPGRADE EXISTING FACILITY		

FIGURE 5



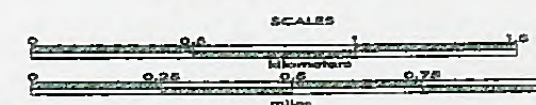
ROBBINSVILLE NORTH CAROLINA

PREPARED BY

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION



Chapter 3

IMPLEMENTATION OF THE THOROUGHFARE PLAN

Once the thoroughfare plan has been developed and adopted, implementation is one of the most important aspects of the transportation plan. Unless implementation is an integral part of this process, the effort and expense associated with developing the plan is lost. There are several tools available for use by Graham County and the Town of Robbinsville to assist in the implementation of the thoroughfare plan. They are described in detail in this Chapter.

County Adoption of the Graham County Thoroughfare Plan

Graham County and the North Carolina Department of Transportation have *not* mutually adopted the recommended thoroughfare plan shown in Figure 2. The County Commissioners have not given any reasons for not adopting the recommended thoroughfare plan.

If the plan was adopted, it would serve as a guide for the Department of Transportation in the development of the road and highway system for the County. Approval of the plan by the County enables standard road regulations and land use controls to be used effectively in the implementation of the thoroughfare plan.

Municipal Adoption of the Robbinsville Thoroughfare Plan

The Town of Robbinsville and the North Carolina Department of Transportation have mutually adopted the thoroughfare plan shown in Figure 3. This mutually adopted plan serves as a guide for the Department of Transportation in the development of the road and highway system for the Town of Robbinsville. The approval of the plan by the Town enables standard road regulations and land use controls to be used effectively in the implementation of this plan. As part of the plan, the Town of Robbinsville and Department of Transportation shall reach agreement on the responsibilities for existing and proposed streets and highways. Facilities which are designated as State responsibility will be constructed and maintained by the Division of Highways. Facilities which are designated as municipal responsibility will be constructed and maintained by the municipality.

Subdivision Controls

Subdivision regulations require every subdivider to submit to the County or Town Planning Board a plan of any proposed subdivision. It also requires that subdivisions be constructed to certain standards. Through this process, it is possible to require the subdivision streets to conform to the thoroughfare plan and to reserve or protect necessary right-of-way for projected roads and highways that are to become a part of the thoroughfare plan. The construction of subdivision streets to adequate standards reduces maintenance costs and simplifies the transfer of

streets to the State Highway System. Appendix C outlines the recommended subdivision design standards as they pertain to road construction.

Land Use Controls

Land use regulations are an important tool in that they regulate future land development and minimize undesirable development along roads and highways. The land use regulatory system can improve highway safety by requiring sufficient setbacks to provide for adequate sight distances and by requiring off-street parking.

Development Reviews

Development access to a state-maintained street or highway is reviewed by the District Engineer's office and by the Traffic Engineering Branch of the North Carolina Department of Transportation. In addition, any development expected to generate large volumes of traffic (e.g., shopping centers, fast food restaurants, or large industries) may be comprehensively studied by staff from the Traffic Engineering Branch, Planning and Environmental Branch, and/or Roadway Design Unit of NCDOT. If done at an early stage, it is often possible to significantly improve the development's accessibility while preserving the integrity of the thoroughfare plan.

Funding Sources

Capital Improvements Program

A local capital improvement program makes it easier to build a planned thoroughfare system. A capital improvement program consists of two lists of projects. The first is a list of highway projects that are designated as a municipal responsibility and are to be implemented with municipal funds. The second is a list of local projects designated as State responsibility to be included in the Transportation Improvement Program. These funds are generally not applicable for County Thoroughfare Plan projects.

Transportation Improvement Program

North Carolina's Transportation Improvement Program (TIP) is a document which lists all major construction projects the Department of Transportation plans for the next seven years. Similar to local Capital Improvement Program projects, TIP projects are matched with projected funding sources. Every other year when the TIP is updated, completed projects are removed, programmed projects are advanced, and new projects are added.

During biannual TIP public hearings, municipalities, counties, and other interested parties request projects to be included in the TIP. A Board of Transportation member reviews all of the project requests in a particular area of the state. Based on the technical feasibility, need, and available funding, the board member decides which projects will be included in the TIP. In addition to highway construction and widening, TIP funds are available for bridge replacement projects, highway safety projects, public transit projects, railroad projects, and bicycle projects.

Industrial Access Funds

If an Industry wishes to develop property that does not have access to a state maintained highway and certain economic conditions are met, then funds may be made available for construction of an access road.

Small Urban Funds

Small Urban funds are annual discretionary funds made to municipalities with qualifying projects. The maximum amount is \$1,000,000 per year per division. A municipality may have multiple projects. Requests for Small Urban Fund assistance should be directed to the NCDOT Program Development Branch or the Division Engineer.

The North Carolina Highway Trust Fund Law

The Highway Trust Fund Law was established in 1989 as a plan with four major goals for North Carolina's roads and highways. These goals are:

1. To complete the remaining 2768 km (1,716 mi) of four lane construction on the 5,800 km (3,600 mi) North Carolina Intrastate System.
2. To construct a multilane connector in Asheville and portions of multilane loops in Charlotte, Durham, Greensboro, Raleigh, Wilmington, and Winston-Salem.
3. To supplement the secondary roads appropriation in order to pave, by 1999, 16,100km (10,000 mi) of unpaved secondary roads carrying 50 or more vehicles per day, and all other unpaved secondary roads by 2006.
4. To supplement the Powell Bill Program.

The portion of this bill which will benefit Graham County and Robbinsville, over the 29 year planning period, is the paving of most, if not all, of its unpaved roads on the State maintained system. Also, there will be an increase in Robbinsville Powell Bill Funds if these newly paved roads are in the Robbinsville Corporate Limits. For more information on the Highway Trust Fund Law, contact the Program Development Branch of the North Carolina Department of Transportation.

Implementation Recommendations

Table 1 provides a break down of the projects recommended in the Graham County and Robbinsville Thoroughfare Plans and the corresponding that would best suit the implementation of the given project.

Table 1

Funding Sources and Methods Recommended for Implementation of Projects								
Funding Sources					Methods of Implementation			
Projects Funds	Local Funds	TIP	Indust. Access	Small Urban	T-fare Plan	Subdiv. Ord.	Zoning Ord.	Developmt. Review
US 74 Rel.		X			X			X
US 129 Wide.		X			X			X
NC 28 Wide.		X			X			X
NC 143 Rel.		X			X			X
Atoah St. Ext.	X				X			X

Construction Priorities and Cost Estimates

Construction priorities will vary depending on what criteria are considered and what weight is attached to the various criteria. Most people would agree that improvements to the major thoroughfare system and major traffic routes would be more important than minor thoroughfares where traffic volumes are lower. To be in the North Carolina Transportation Improvement Program, a project should show favorable benefits relative to costs and should not be prohibitively disruptive to the environment. The potential cost estimate of three Graham County and Town of Robbinsville projects with respect to the user benefits, and the probabilities that economic development will be stimulated and environmental impact will be minimized are given in Table 3. A guide to this table is shown in Table 2. Due to pending construction status, two of the thoroughfare plan projects (US 74 Relocation and NC 143 Relocation), did not have benefits calculated. Both of these projects are scheduled to begin construction in the next seven years, according to the 1998-2004 Transportation Improvement Program.

Table 2

Probability Estimation Guide	
Subjective Evaluation	Impact Probability
Excellent - very substantial	1.00
Very good - substantial	0.75
Good - considerable	0.50
Fair - some	0.25
Poor - none	0.00

Reduced road user cost should result from any roadway improvement, from a simple widening to the construction of a new roadway. Roadway improvements should also relieve congested or unsafe conditions. Comparisons of the existing and the proposed facilities have been made in terms of vehicle operating costs, travel time costs, and accident costs. These user benefits are computed as total dollar saving over the 29 year design period using data such as project length,

base year and design year traffic volumes, traffic speed, type of facility, and volume capacity ratio.

The impact of a project on economic development potential is shown as the probability that it will stimulate the economic development of an area by providing access to developable land and reducing transportation costs. It is a subjective estimate based on the knowledge of the proposed project, local development characteristics, and land development potential. The probability is rated on a scale from 0 (representing no development potential) to 1.00 (representing excellent development potential).

The environmental impact analysis considers the effect of a project on the physical, social/cultural, and economic environment. Below are listed the thirteen items that are considered when evaluating the impacts on the environment

- * air quality
- * water resources
- * soils and geology
- * wildlife
- * vegetation
- * neighborhoods noise
- * noise
- * educational facilities
- * churches
- * parks and recreational facilities
- * historic sites and landmarks
- * public health and safety
- * aesthetics

The environmental impact analysis also uses a probability rating from 0 (representing no benefit to the environment) to 1.00 (representing a positive impact to the environment.) A negative value is assigned to the probability to indicate a negative impact. The summation of both positive and negative impacts probabilities with respect to these factors provides a measure of the relative environmental impacts of a project. Table 2 shows the probability scale used in the analysis. This table can be used as a guideline for interpreting the “Economic Development” and Environmental Impact” values given in Table 3.

Table 3

Benefits Evaluation for Major Projects						
Projects	Benefits (millions)	Costs (millions)	Length km	Benefits/ km	Economic Development	Envirm. Impact
US 129 Widening	9.19	3.95	4.00	2,297,000	+0.20	+0.25
NC 28 Widening	7.86	29.70	21.06	373,200	+0.10	+0.15
Atoah Street Ext.	3.14	0.57	0.79	3,974,600	+0.25	+0.05

*US 74 Relocation and NC 143 Relocation not included due to their pending construction status

Offsetting the benefits that would be derived from any project is the cost of its construction. A new facility, despite its high projected benefits, might prove to be unjustified due to the excessive costs involved in construction. The highway costs estimated in this report are based on the average statewide construction costs for similar project types. The anticipated right-of-way costs is also included as an average cost per acre for property throughout the Graham County and Robbinsville Planning Area according to the respective project. Table 4 provides a break down of total project cost into construction cost and right-of-way cost for the major project proposals for the Thoroughfare Plan. US 74 Relocation is not included in the cost estimate, because no cost estimate for only the Graham County portion of this project is available. The entire project cost, from Swain County to Cherokee County is \$341,408,000, according to the 1998-2004 TIP.

Table 4

**Potential Cost Estimates for Major
Projects**

Project Description	Construction Cost	Right-of-way Cost	Total Cost
US 129 Widening	\$3,708,000	\$237,000	\$3,945,000
NC 28 Widening	\$24,300,000	\$5,400,000	\$29,700,000
NC 143 Relocation	\$12,555,000	\$700,000	\$13,255,000
Atoah Street Ext.	\$519,000	\$55,000	\$574,000

* The cost estimate for US 74 Relocation is not included because it extends into three counties

Chapter 4

ANALYSIS OF GRAHAM COUNTY'S ROADWAY SYSTEM

This chapter presents an analysis of the ability of the existing street system to serve the area's travel desires. Emphasis is placed not only on detecting the deficiencies, but on understanding their cause. Travel deficiencies may be localized and the result of substandard highway design, inadequate pavement width, or intersection controls. Alternately, the underlying problem may be caused by a system deficiency such as a need for a bypass, loop facility, construction of missing links, or additional radials.

An analysis of the roadway system must first look at existing travel patterns and identify existing deficiencies. This includes roadway capacity and safety analysis. After the existing picture of travel in the area has been developed, the engineer must analyze factors that will impact the future system. These factors include forecasted population growth, economic development potential, and land use trends. This information will be used to determine future deficiencies in the transportation system.

Current Transportation Plans for Graham County and Robbinsville

Thoroughfare Plans

Thoroughfare Plans are a tool to aid officials in the development of an appropriate street system. It is important that the communities within a County, and County Officials cooperate as a team in the development of this transportation system. Plan development and implementation jointly undertaken will help ensure the development of an efficient system for travel throughout the County.

The 1998 Graham County Thoroughfare Plan and the 1998 Robbinsville Thoroughfare Plan are the first transportation studies completed in this county.

Transportation Improvement Program Projects

As covered in Chapter 3, the Transportation Improvement Program (TIP) is a seven year project planning document that lists the major transportation improvement projects that the Department of Transportation has planned. These projects include not only roadway projects, but also bridge projects, railroad crossings, bicycle facilities, and public transportation. Graham County has several projects listed in the 1998-2004 TIP, and the major projects are listed below. The project numbers are listed in parenthesis.

1. US 74 Relocation, from US 19-74-129 at Andrews to NC 28 east of Almond. Construct a four lane divided facility, primarily on new location. (A-9)
2. NC 28, upgrade existing two lane roadway (R-2407)
3. NC 143, upgrade roadway, some relocation (R-2822)

Existing Travel Patterns and Deficiencies

Traffic Demand

Travel demand is generally reported in the form of average daily traffic counts. Traffic counts are taken regularly at several locations within Graham County by the North Carolina Department of Transportation. The 1996 average daily traffic counts for Graham County and Robbinsville are shown in Figure 6.

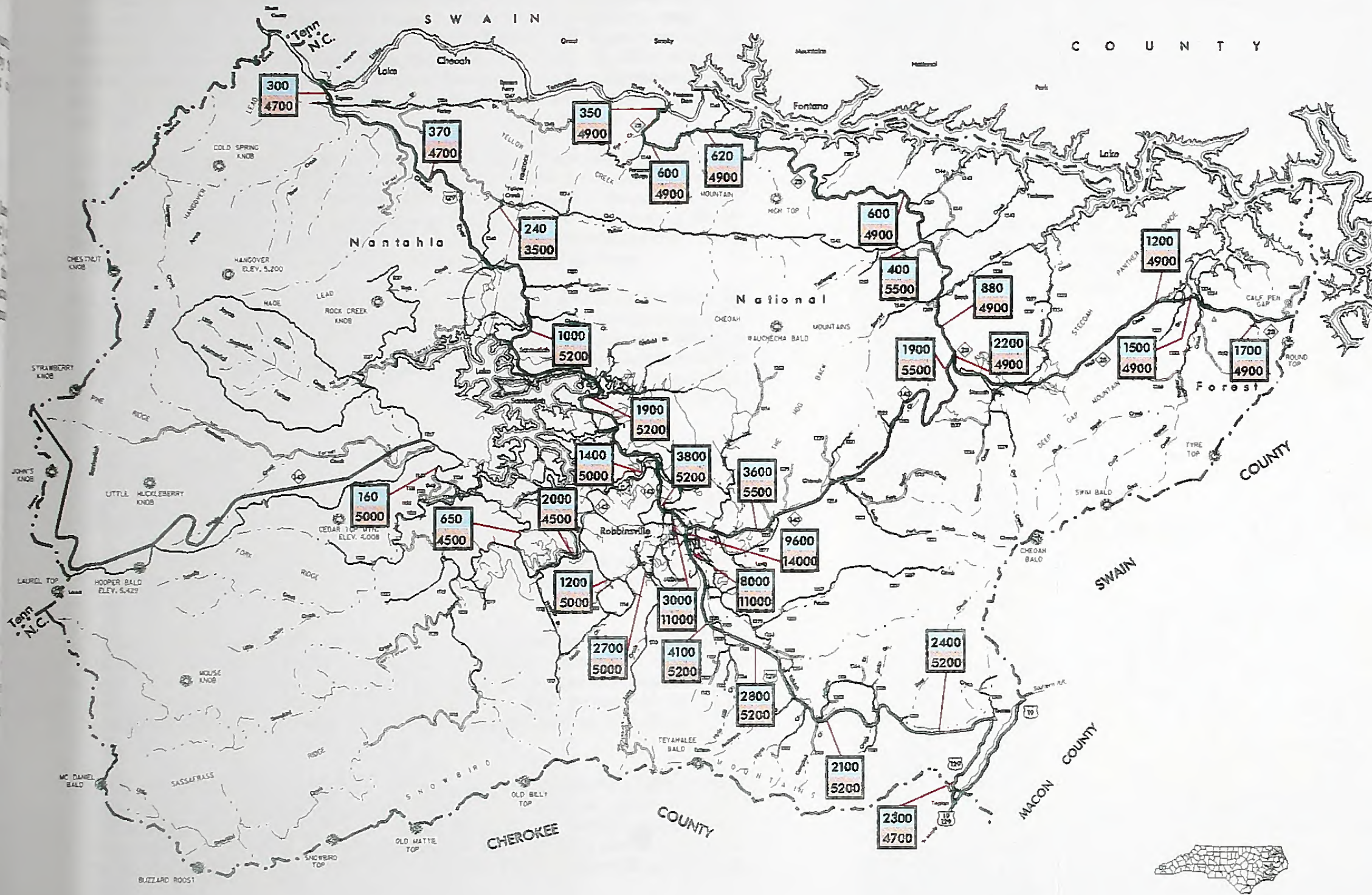
Width and Alignment Deficiencies

North Carolina's standard for highway construction calls for 3.35 m (11 ft) lanes on all highways with traffic volumes greater than 2,000 ADT (Average Daily Traffic) or design speeds greater than 50 miles per hour. This includes all primary arterials. A 2.74 m (9 ft) minimum lane width can be tolerated on collector roads with an ADT of less than 4,300 vehicles per day. The minimum level of service for minor collector roads dictates a 40 mph design speed during peak traffic conditions. These standards are summarized in Table 5.

Table 5						
Minimum Tolerable Lane Widths						
Average Daily Traffic	Principal Arterials		Minor Arterials		Collectors	
	meters	feet	meters	feet	meters	feet
over 2,000	3.35	11	3.35	11	3.35	11
400 - 2000	-	-	3.05	10	3.05	10
100 - 400	-	-	3.05	10	2.74	9
below 100	-	-	-	-	2.74	9

There are a number of roadways in Graham County that have substandard widths. Because of the substantial cost of upgrading all secondary roads to standard, narrow widths may have to be tolerated until sufficient funds are available for improvements. The roads identified as a part of the Graham County and Robbinsville Thoroughfare Plan studies are listed below:

- NC 143 (Snowbird Rd.): NC 143 (Massey Branch Rd.) - Cherohala Skyway
- NC 143 (Massey Branch Rd.): NC 143 (Snowbird Rd.) - US 129
- NC 143 Bus. (Snowbird Rd.): SCL Robbinsville - NC 143 (Massey Branch Rd.)
- SR 1206 (Old Tallulah Road): SR 1275 (Five Points Road) - US 129
- SR 1242 (Tuskegee Road) : US 129 - SR 1274 (Turpin Road)



1996 AVERAGE DAILY TRAFFIC AND CAPACITIES

LEGEND

1996 ADT
1996 CAPACITY

0000
0000

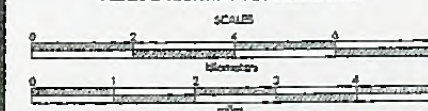
NOTE: MOST ADT'S ARE TAKEN DIRECTLY FROM 1996 ADT MAPPING. SOME COUNTS WERE TAKEN FROM 1995 MAPPING.

FIGURE 6



GRAHAM COUNTY NORTH CAROLINA

PREPARED BY TPO
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION



Capacity Analysis of the Existing System

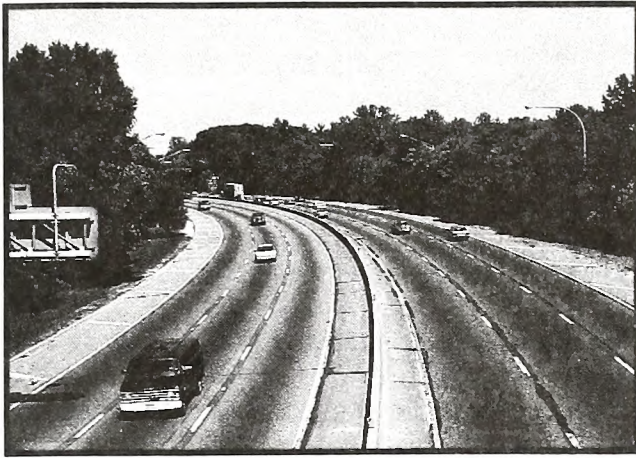
An indication of the adequacy of the existing street system is a comparison of traffic volumes versus the ability of the streets to move traffic freely at a desirable speed. The ability of a street to move traffic freely, safely, and efficiently with a minimum delay is controlled primarily by the spacing of major devices utilized. Thus, the ability of a street to move traffic can be increased by restricting parking and turning movements, using proper sign and signal devices, and by the application of other traffic engineering strategies.

Capacity is the maximum number of vehicles which has a “reasonable expectation” of passing over a given section of a roadway, during a given time period under prevailing roadway and traffic conditions. The relationship of traffic volumes to the capacity of the roadway will determine the level of service (LOS) being provided. Six levels of service have been selected for analysis purposes. They are given letter designations from A to F with LOS A representing the best operating conditions and LOS F the worst.

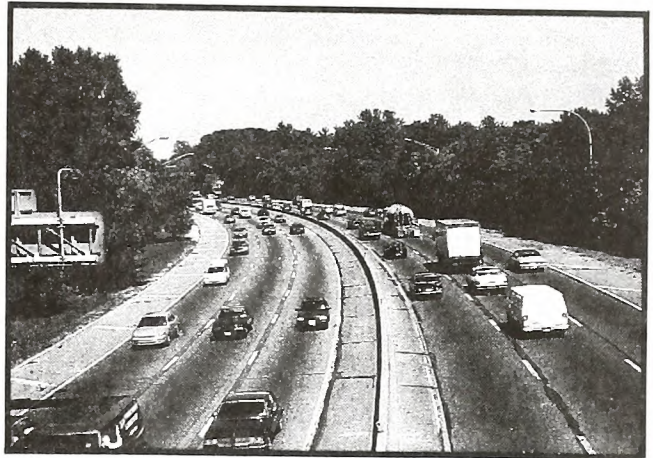
The six levels of service are illustrated in Figure 7 and they are defined on the following pages. The definitions are general and conceptual in nature, but may be applied to urban arterial levels of service. Levels of service for interrupted flow facilities vary widely in terms of both the user’s perception of service quality and the operational variables used to describe them. The 1995 Highway Capacity Manual contains more detailed descriptions of the levels of service as defined for each facility type. The six levels of service are outlined below.

- **LOS A** - Describes primarily free flow conditions. The motorist experiences a high level of physical and psychological comfort. The effects of minor incidents of breakdown are easily absorbed. Even at the maximum density, the average spacing between vehicles is about 161 m (528 ft), or 26 car lengths.
- **LOS B** - Represents reasonably free flow conditions. The ability to maneuver within the traffic stream is only slightly restricted. The lowest average spacing between vehicles is about 101m (330 ft), or 18 car lengths.
- **LOS C** - Provides for stable operations, but flows approach the range in which small increases will cause substantial deterioration in service. Freedom to maneuver is noticeably restricted. Minor incidents may still be absorbed, but the local decline in service will be great. Queues may be expected to form behind any significant blockage. Minimum average spacing are in the range of 67 m (220 ft), or 11 car lengths.
- **LOS D** - Borders on unstable flow. Density begins to deteriorate somewhat more quickly with increasing flow. Small increases in flow can cause substantial deterioration in service. Freedom to maneuver is severely limited, and the driver experiences drastically reduced comfort levels. Minor incidents can be expected to create substantial queuing. At the limit, vehicles are spaced at about 50 m (165 ft), or nine car lengths.

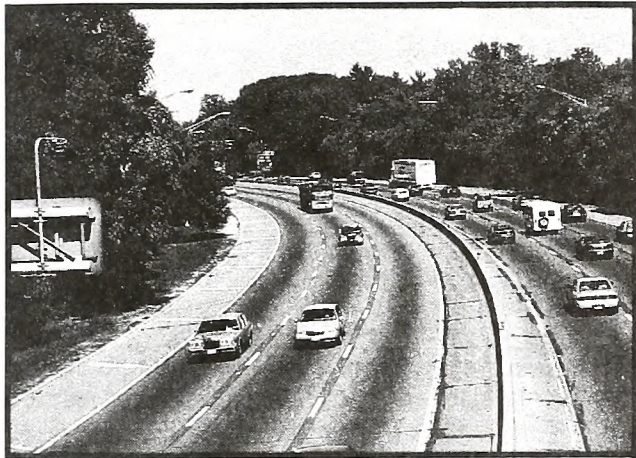
- **LOS E** - Describes operation at capacity. Operations at this level are extremely unstable, because there are virtually no usable gaps in the traffic stream. Any disruption to the traffic stream, such as a vehicle entering from a ramp, or changing lanes, requires the following vehicles to give way to admit the vehicle. This can establish a disruption wave that propagates through the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate any disruption. Any incident can be expected to produce a serious breakdown with extensive queuing. Vehicles are spaced at approximately six car lengths, leaving little room to maneuver.
- **LOS F** - Describes forced or breakdown flow. Such conditions generally exist within queues forming behind breakdown points.



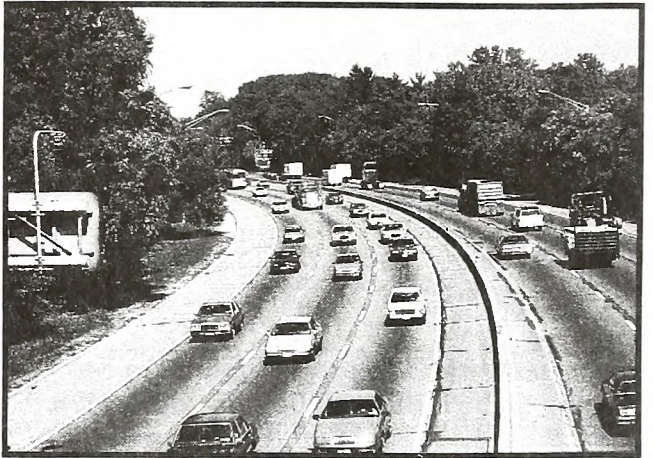
LOS A.



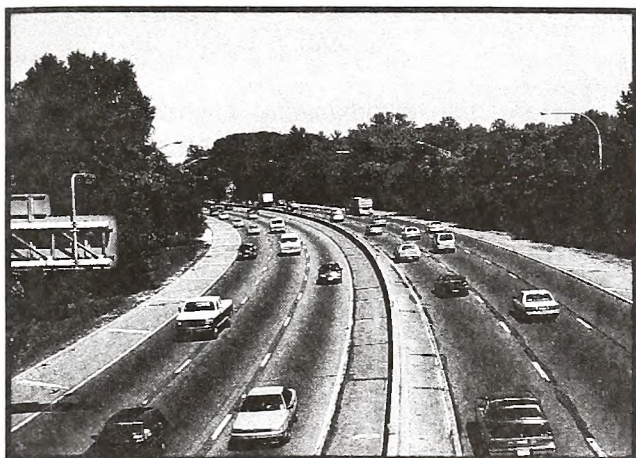
LOS D.



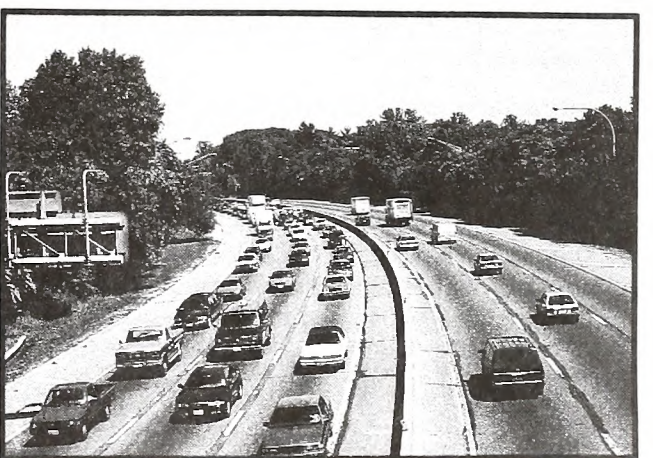
LOS B.



LOS E.



LOS C.



LOS F.

Traffic Accidents

Traffic accidents are often used as an indicator for locating congestion problems. Traffic accident records can also be reviewed to identify problem locations or deficiencies such as poor design, inadequate signing, ineffective parking, or poor sight distance. Accident patterns developed from analysis of accident data can lead to improvements that will reduce the number of accidents.

Table 6 is a summary of the accidents occurring in Graham County between January, 1994, and December, 1996. This table only includes locations with 5 or more accidents. The "Total" column indicates the total number of accidents reported within 61 m (200 ft) of the intersection during the study period indicated. The severity listed is the average accident severity for that location.

Table 6

Locations with 5 or More Accidents in a 3-Year Period

Locations	Angle	Rear End	Ran Off Road	Left Turn	Right Turn	Other	Total	Severity
US 129/ SR 1155	1	4		1		1	7	26.89
US 129/NC 143S	1	1	1	4			7	2.06
US 129/SR 1106*	4	2	2	6			14	15.00
US 129/ Patton	2	1		3			6	1.00
NC 143B/SR 1106		1		2	1	2	6	3.47

*The current NC 143 Business (Main Street) inside of Robbinsville was signed SR 1106 (Main Street) during most of this study period. There were 2 entrances to SR 1106 to US 129. It can be safe to assume that the 14 accidents is a combination of the two intersections.

Both the severity and number of accidents should be considered when investigating accident data. The severity of every accident is measured with a series of weighting factors developed by NCDOT's Division of Highways. In terms of these factors, a fatal or incapacitating accident is 47.7 times more severe than one involving only property damage, and an accident resulting in minor injury is 11.8 times more severe than one with only property damage.

During a thoroughfare plan meeting on October 17, 1996, the Town of Robbinsville requested that the intersection with NC 143 Business (then called SR 1127) and SR 1106 (Tallulah Road), and the intersection of SR 1275 (Five Points Road) and US 129 should be studied for the feasibility of a traffic signal. This request was forwarded to the Division Traffic Engineer's Office in early 1997 for study. Their investigation concluded that traffic signals were not warranted at that time. To request a more detailed accident analysis for any of the above mentioned intersections, or other intersection of concern, the County or Town should contact the Division 14 Traffic Engineer.

Existing Bridge Conditions

Bridges are a vital and unique element of a highway system. First, they represent the highest unit investment of all elements of the system. Second, any inadequacy or deficiency in a bridge reduces the value of the total investment. Third, a bridge presents the greatest opportunity of all potential highway failures for disruption of community welfare. Finally, and most importantly, a bridge represents the greatest opportunity of all highway failures for loss of life. For these reasons, it is imperative that bridges be constructed to the same design standards as the system of which they are a part.

Congress enacted the National Bridge Inspection Program Standards on April 27, 1971, implementing the Federal Highway Act of 1968. These standards require that "all structures designed as bridges located on any of the Federal-Aid Highway Systems be inspected and the safe load carrying capacity computed at regular intervals, not to exceed two years." A sufficiency index number has been calculated for each bridge to establish eligibility and priority for replacement. The bridges with the highest priority are replaced as Federal-Aid funds and State funds become available.

The North Carolina DOT's Bridge Maintenance Unit, with assistance from various consultants, inspect all bridges on the State Highway System. All bridges in Graham County have been analyzed, rated, and inventoried. The resulting data has been reduced to a more readily usable form as a management tool.

A sufficiency rating was used in the analysis to determine the deficiency of each bridge. The sufficiency rating is a method of evaluating factors that determine whether a bridge is sufficient to remain in service. Factors used include:

- structural adequacy and safety
- serviceability and functional obsolescence
- essentially for public use
- type of structure
- traffic safety features

The result of this method is a percentage in which 100 percent represents an entirely sufficient bridge and zero percent represents an entirely insufficient or deficient bridge. A sufficiency rating of 50 percent or less qualifies for Federal Bridge Replacement Funds.

Deficient bridges are categorized as either functionally obsolete or structurally deficient. Bridges in the functionally obsolete category have below average ratings in approach roadway alignment, under clearance, deck geometry, waterway adequacy, or structural condition. Structurally deficient bridges have below average ratings in deck superstructure, substructure, overall structural condition, or waterway adequacy. Table 7 shows the functionally obsolete bridges in Graham County. Table 8 shows all the structurally deficient bridges in Graham County.

Table 7

Functionally Obsolete Bridges in Graham County (ratings < 50.0)			
Bridge No.	Facility Carried	Location	Rating
22	SR 1214	Mountain Creek	45.8
28	SR 1223	Beech Creek	42.5
70	SR 1134	Cheoah River	48.5
81	SR 1117	Long Creek	46.2
101	SR 1113	Atoah Creek	43.9
107	SR 1214	Mountain Creek	47.5

Table 8

Structurally Deficient Bridges in Graham County			
Bridge No.	Facility Carried	Location	Rating
29	SR 1206	Franks Creek	54.2
47	SR 1232	Panther Creek	35.2
67	SR 1232	Panther Creek	60.5
68	SR 1232	Panther Creek	9.0
114	SR 1237	Stecoah Creek	38.0
117	SR 1123	West Buffalo Creek	45.1
119	SR 1105	Mill Creek	34.2

Of these bridges, the following are included in the 1998-2004 Transportation Improvement Program. Included in parenthesis is the TIP project number, and their estimated construction date.

- Bridge No. 28 (B-3641), construction in 2003
- Bridge No. 47 (B-3642), construction in 2003
- Bridge No. 68 (B-3457), construction in 2002
- Bridge No. 70 (B-3335), construction in 2002
- Bridge No. 114 (B-3458), construction in 2002

Factors Affecting the Future Roadway System

The objective of thoroughfare planning is to develop a transportation system that will meet future travel demand and enable people and goods to travel safely and economically. To determine the needs of an area it is important to understand the role of population, economics, and land use have on the highway system. Examination of these factors helps to explain historic travel patterns and lays the groundwork for thoroughfare planning.

In order to formulate an adequate year 2025 thoroughfare plan, reliable forecasts of future travel characteristics must be achieved. The factors of population, vehicle usage trends, economy and

land use play a significant role in determining the transportation needs of the area, and must be carefully analyzed. Additional items may include the effects of legal controls such as subdivision regulations and zoning ordinances, availability of public utilities and physical features of the area.

The first step in the development of the thoroughfare plan is to define the planning period and the planning area. The planning period is typically on the order of 30 years. The base year for the Graham County and Robbinsville study was 1994 (later updated to 1996), and the year 2025 was chosen to be the end point of the study period (29 years). The planning area for the Graham County study is simply the county boundaries. The planning area for the Robbinsville study is approximately one mile from the municipal limits.

Population

The amount of traffic on a section of roadway is a function of the size and location of the population which it serves. Investigating past trends in population growth and forecasting future population growth and dispersion is one of the first steps for a transportation planner. Table 9 shows the historical and projected population trends for Graham County and the Town of Robbinsville through 2025. Population within Graham County has been fluctuating since 1970. However, with the possible construction of US 74 Relocation and the recent opening of the Cherohala Skyway, there is reason to believe there will be an increase in population in the study period, because of improved access to the county.

Table 9

Population Trends and Projections		
Year	Robbinsville	Graham County
1970	777	6,562
1980	814	7,217
1990	709	7,196
1996	794	7,538
2000	809 ^a	7,712 ^b
2010	851 ^a	7,758 ^b
2020	895 ^a	7,651 ^b
2025	918 ^a	7,844 ^a

a = Projections made by Statewide Planning Branch

b = Projections made by State Budget & Management

Economy and Employment

One of the more important factors to be considered in estimating the future traffic growth of an area is its economic base. The number of employers and the employee's income or purchasing power influences how much population can be supported in the area and the number of motor vehicles that will be locally owned and operated. Generally, as the family income increases so does the number of vehicles owned, as well as the number of vehicles trips generated per day by each household. An accurate projection of the future economy of the area is essential to estimating future travel demand.

Factors which will influence economic growth and development in Graham County and Robbinsville over the 29 year planning period is development along US 129 near Robbinsville. The US 74 Relocation is expected to have a huge impact on accessibility to the county, and is intended to spur economic growth and development. This road will provide for more efficient transportation of raw materials and finished goods to and from manufacturers in Graham County.

Approximately 35% of the work force is in manufacturing, 54% nonmanufacturing, and 3% in agriculture. Stanley Furniture in Robbinsville is the county's largest employer, with over 500 employees. One large problem in the county is unemployment, which is about 25%.

Land Use

Land use refers to the physical patterns of activities and functions within a city or county. Nearly all traffic problems in a given area can attributed in some form to the type of land use. For example, a large industrial plant might be the cause of congestion during shift change hours as its workers come and go. However, during the remainder of the day few problems, if any, may occur. The spatial distribution of different types of land use is the predominant determinant of when, where, and why congestion occurs. The attraction between different land uses and their association with travel varies depending on the size, type, intensity, and spatial separation of each.

For use in transportation planning, land uses are grouped into four categories:

1. Residential - all land devoted to the housing of people (excludes hotels and motels)
2. Commercial - all land devoted to retail trade including consumer and business service and office.
3. Industrial - all land devoted to manufacturing, storage, warehousing, and transportation of products
4. Public - all land devoted to social, religious, educational, cultural, and political activities.

Graham County is sparsely populated. There are small communities scattered throughout the county, with the largest being the county seat, Robbinsville. Development and land use is similar with scattered rural residential along streams in valleys and in coves. Summer residences are found in other areas. A great majority of the land in the county is rugged terrain in undeveloped woodland, mostly within the Nantahala National Forest.

There are two incorporated communities in Graham County. Robbinsville, the county seat with a 1996 population of 794, and Santeetlah with a population of 46.

Forecasted Travel Patterns and Deficiencies

Future Travel Demand

Travel demand is generally reported in average daily traffic counts. Traffic counts are taken regularly in and around Graham County by the North Carolina Department of Transportation. To estimate future travel demand, traffic trends over the past twenty years were studied. A comparison of annual growth rates from 1965 to 1994 at various count locations in Graham County shows the average annual growth rates ranging from 1% to 4% . The largest growth was noted on the major roads. Traffic was projected to grow on all major roads by 1% to 2.5%, except the Cherohala Skyway and NC 143 (Snowbird, Massey Branch Road), with growth rates of about 4% to accommodate tourist traffic. Figure 6 shows existing Average Daily Traffic and Figures 8 and 9 show anticipated traffic volumes for Graham County and Robbinsville.

The introduction of new residential, commercial, and tourist developments in the county will cause increases in traffic growth in those immediate areas. Eventually, this increase will level off and follow the growth pattern of the surrounding area.

2025 Traffic Capacity Analysis

Capacity deficient corridors were determined using the volume/capacity ration (V/C) with the projected traffic over the practical capacity of the facility. A V/C ratio of less than one is tolerable. Based on this analysis, several roadways in Graham County are anticipated to be inadequate by the planning year 2025. These roads are shown in red on Figures 8 and 9.

An analysis of the roads in Graham County was made to determine if the projected traffic (2025) would exceed the practical capacity of the system. In this analysis, it was assumed that US 74 Relocation and NC 143 Relocation would be constructed, since both of these projects are currently funded for construction. However, due to the enormous effect that US 74 Relocation will have on the area, it is unclear how it will effect traffic patterns. Therefore, recommendations for the county were conservative until a more clear picture is defined. Based on these analysis, these facilities were projected to exceed their practical capacities within the design period.

- US 129 between the Northern Corporate Limits of Robbinsville and NC 143 (North). This section is recommended to be improved to 7.3 m (24 ft) with turn lanes at major intersections.
- US 129 between NC 143 (South) and the Southern City Limits of Robbinsville. This three lane section is expected to have 18,700 vpd. The improvement to a five lane section should alleviate this deficiency.

- US 129 between the Southern City Limits of Robbinsville and SR 1260 (Roberts Road). This road is planned to be widened to three lanes in late 1998. Future traffic projections of 14,100 indicate that this section will be over capacity by the year 2025. No further improvements are planned for this section as some of the impacts of US 74 Relocation are unclear.
- US 129 between SR 1260 (Airport Road) and SR 1204 (West Road). This section is anticipated to be slightly over capacity in the design year. No further improvements are planned for this section as some of the impacts of US 74 Relocation are unclear.
- NC 143 (Snowbird Road) between the Cherohala Skyway and NC 143 Business. This section is expected to exceed capacity due to tourist traffic. The improvement of this route by some relocation and the upgrading of the existing roadway should alleviate this deficiency.
- NC 143 (Massey Branch Road) is recommended to be widened to 7.3 m (24 ft) to improve safety and capacity.
- NC 143 Business (Snowbird Road) between the Southern City Limits of Robbinsville and NC 143 is expected to be slightly over capacity in the design year. This section is recommended to be widened 7.3 m (24 ft) to improve safety and capacity.

No Build Alternative

Not implementing a thoroughfare plan or elements of it could be called a No-Build Alternative. This means that there would be no new construction or roadway improvements to the Graham County and Robbinsville Thoroughfare system except for routine maintenance. If no improvements are made to US 129, NC 143, or the US 74 Relocation is not constructed during the planning period, the increase traffic volumes and normal growth will result in a dramatic reduction in transportation quality. In some areas of the county, the operating speed will drop significantly, and the queues of traffic currently experienced behind slow moving vehicles will get considerably longer. The absence of improvements will negatively impact growth, business, and tourist industry in the Graham County and Robbinsville area.

These sections are expected to exceed capacity without future improvements:

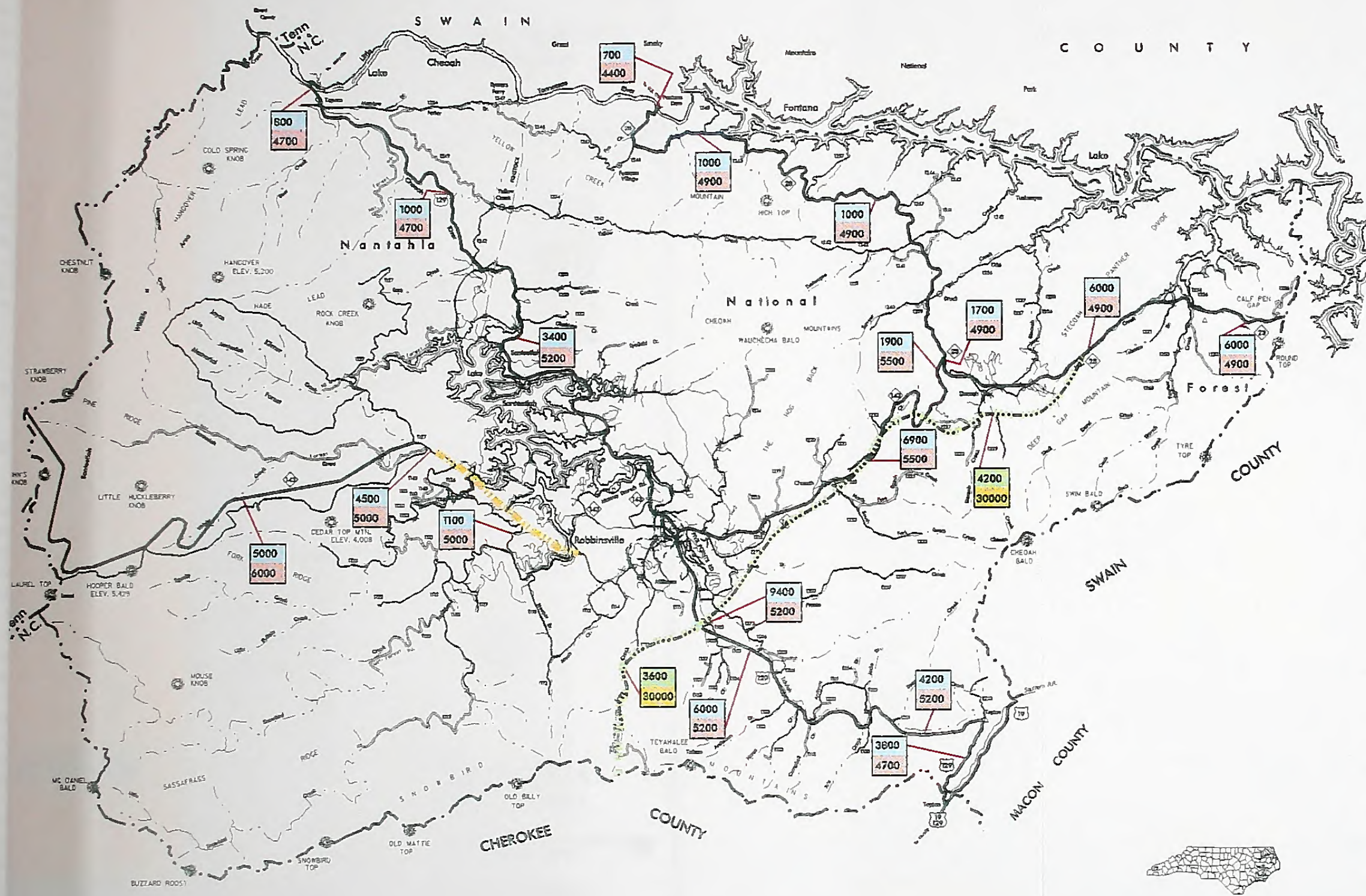
- US 129 between the Northern Corporate Limits of Robbinsville and NC 143 (North).
- US 129 between NC 143 (South) and SR 1204 (West Road).
- NC 143 (Snowbird Road) between the Cherohala Skyway and NC 143 Business.
- NC 143 (Massey Branch Road)
- NC 143 Business (Snowbird Road) between the Southern City Limits of Robbinsville and NC 143.
- NC 143 Business (Janaluska Road) between Masonic Street and Atoah Street

2025 AVERAGE DAILY TRAFFIC AND CAPACITY

LEGEND

MAJOR COLLECTOR	8000 15000	PROPOSED
MINOR COLLECTOR	1000 5000	PROPOSED
2025 ADT	0000	DESIGN YEAR ADT
1996 CAPACITY	0000	BASE YEAR ADT
2025 PROJECTED	0000	
2025 CAPACITY	0000	

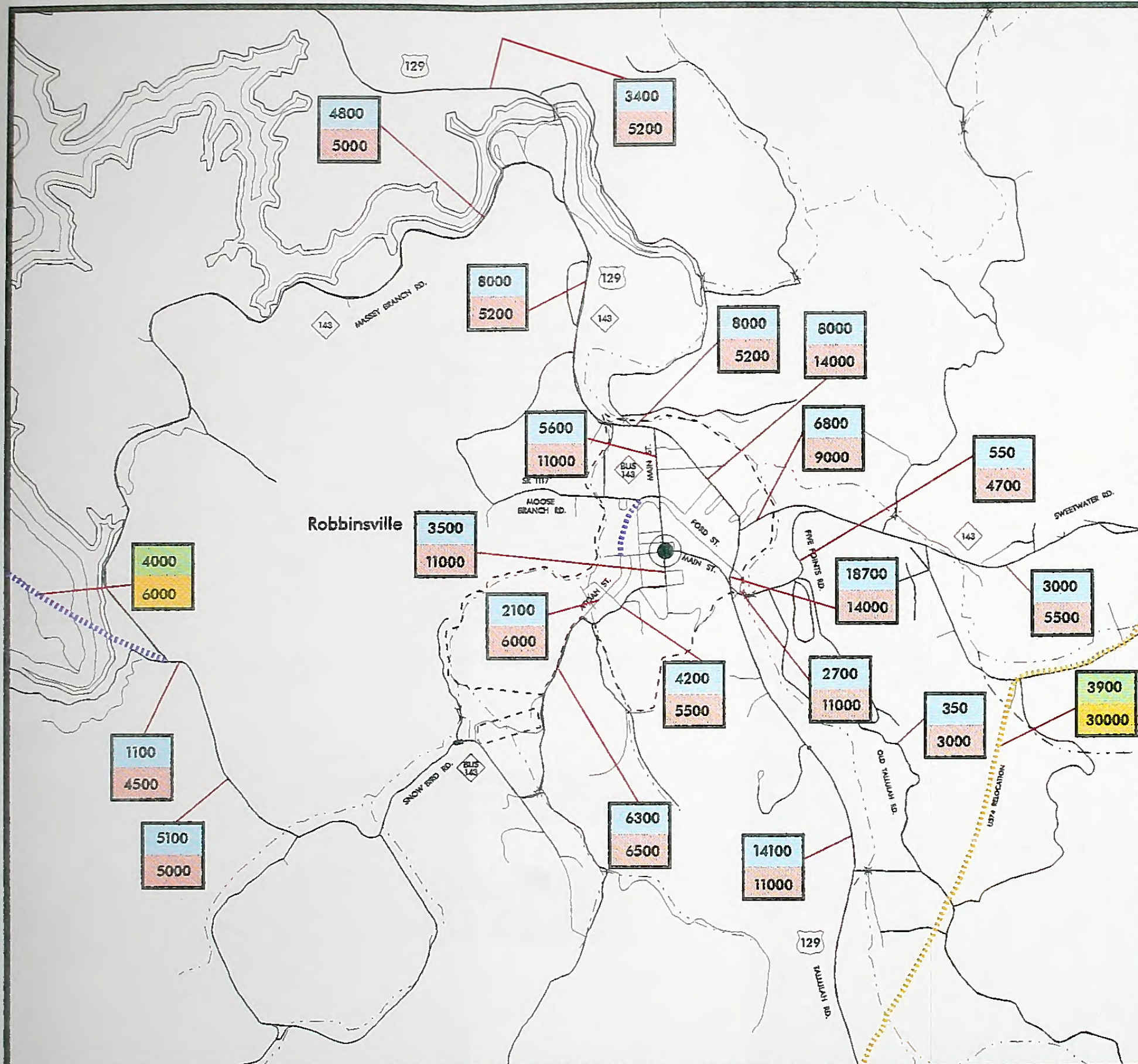
FIGURE 8



GRAHAM COUNTY NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION





EXISTING AND PROJECTED TRAFFIC VOLUMES

LEGEND

	WIDENING	PROPOSED
4 LANES DIVIDED		
2 - 12' LANES		
2025 PROJECTED		
1996 CAPACITY		
2025 PROJECTED		
2025 CAPACITY		

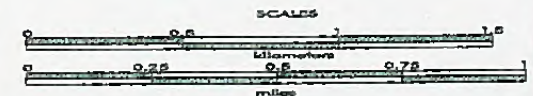
FIGURE 9



ROBBINSVILLE NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION



Consideration of Environmental Factors

In the past several years, environmental considerations associated with highway construction have come to the forefront of the planning process. The legislation that dictates the necessary procedures regarding environmental impacts is the National Environmental Policy Act. Section 102 of this act requires the execution of an environmental impact statement, or EIS, for road projects that have a significant impact on the environment. Included in an EIS would be the project's impact on wetlands, water quality, historic properties, wildlife, and public lands. While this report does not cover the environmental concerns in as much detail as an EIS would, preliminary research was done on several of these factors and is included below.

Wetlands

In general terms, wetlands are lands where saturation with water is the dominant factor in determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrata that is at least periodically saturated with or covered by water. Water creates severe physiological problems for all plants and animals except those that are adapted for life in it or in saturated soil.

Wetlands are crucial ecosystems in our environment. They help regulate and maintain the hydrology of our rivers, lakes, and streams by slowly storing and releasing flood waters. They help maintain the quality of our water by storing nutrients, reducing sediment loads, and reducing erosion. They are also critical to fish and wildlife populations. Wetlands provide an important habitat for about one third of the plant and animal species that are federally listed as threatened or endangered.

In this study, the impacts to wetlands were determined using the National Wetlands Inventory Mapping, available from the U. S. Fish and Wildlife Service.

Wetland impacts have been avoided or minimized to the greatest extent possible while preserving the integrity of the transportation plan.

Threatened and Endangered Species

A preliminary review of the Federally Listed Threatened and Endangered Species within Graham County was done to determine the effects that new corridors could have on the wildlife. These species were identified using mapping from the North Carolina Department of Environment, Health, and Natural Resources.

The Threatened and Endangered Species Act of 1973 allows the U. S. Fish and Wildlife Service to impose measures on the Department of Transportation to mitigate the environmental impacts of a road project on endangered plants and animals and critical wildlife habitats. By locating rare species in the planning stage of road construction, we are able to avoid or minimize these impacts.

Due to the rural nature of the county, there are dozens of threatened or endangered species identified in Graham County, especially in the Nantahala National Forest. The species include plants and animals. Due to the amount of threatened and endangered species in Graham County, a detailed list was not compiled, due to the preliminary nature of this study.

Graham County supports a diverse assemblage of plant life. Because of the topographic and altitudinal differences throughout the areas, species diversity is high. Different types of forests are present. The threatened and endangered plant species are mostly found in the western part of the county, in the Nantahala National Forest. However, some occurrences are found near the Cherokee County border and Wauchecha Bald.

The majority of land in the project area is highly valuable to wildlife. Food, cover, and water, three essential elements to sustain wildlife populations, are available throughout the project area. Occurrences of the black bear, boar, white-tailed deer, and the cougar have been documented. Many of the threatened and endangered animals are located near Johns Knob near the Tennessee State Line, and west of Fontana Village.

A detailed field investigation is recommended prior to construction of any highway project in this area.

Historic Sites

The location of historic sites in Graham County was investigated to determine the possible impacts of the various projects studied. The federal government has issued guidelines requiring all State Transportation Departments to make special efforts to preserve historic sites. In addition, the State of North Carolina has issued its own guidelines for the preservation of historic sites. These two pieces of legislation are described below:

- **National Historic Preservation Act** - Section 106 of this act requires the Department of Transportation to identify historic properties listed in the National Register of Historic Places and properties eligible to be listed. The DOT must consider the impacts of its road projects on these properties and consult with the Federal Advisory Council on Historic Preservation.
- **NC General Statute 121-12(a)** - This statute requires the DOT to identify historic properties listed on the National Register, but not necessarily those eligible to be listed. DOT must consider impacts and consult with the North Carolina Historical Commission, but it is not bound by their recommendations.

There are currently seven properties in the Graham County that are listed on the National Register of Historic Places. The following is a list of Historic Places on the National Register in the Graham County Planning Area.

- Snowbird Mountain Lodge (near NC 143)
- Charles Noden George House (near SR 1200, near Topton)
- Janaluska's Grave (south side of NC 143 Business, near SR 1108 - Robbinsville)
- Jesse Gunther College (near SR 1245 near Fontana Dam)
- Fontana Dam (near northern Swain County line and NC 28)
- Lake Cheoah Dam (near US 129 and Little Tennessee River)

None of these properties should be affected by the projects proposed on the thoroughfare plan. Little historic study has been accomplished in this county, but it was given a reconnaissance study. Care should be taken to make certain that all historic sites and natural settings are preserved. Therefore, a closer study should be done in regard to the local historic sites prior to the construction of any proposal.

Appendix A

THOROUGHFARE PLANNING PRINCIPLES

There are many advantages to thoroughfare planning, but the primary mission is to assure that the road system will be progressively developed to serve future travel desires. Thus, the main consideration in thoroughfare planning is to make provisions for street and highway improvements so that, when the need arises, feasible opportunities to make improvements exist.

Benefits of Thoroughfare Planning

There are two major benefits derived from thoroughfare planning. First, each road or highway can be designed to perform a specific function and provide a specific level of service. This permits savings in right-of-way, construction, and maintenance costs. It also protects residential neighborhoods and encourages stability in travel and land use patterns. Second, local officials are informed of future improvements and can incorporate them into planning and policy decisions. This will permit developers to design subdivisions in a non-conflicting manner, direct school and park officials to better locate their facilities, and minimize the damage to property values and community appearance that is sometimes associated with roadway improvements.

County Thoroughfare Planning Concepts

The underlying notion of the thoroughfare plan is to provide a functional system of streets, roads, and highways that permit direct, efficient, and safe travel. Different elements in the system are designed to have specific functions and levels of service, thus minimizing the traffic and land use conflict.

In the county plan, elements are either urban or rural. In the rural planning area, the local municipality generally has planning jurisdiction. In those urban areas where no urban thoroughfare plan exists, elements are rural and are under the planning jurisdiction of the county.

Within the urban and rural systems, plan elements are classified according to the specific function they are to perform. A discussion of these elements and functions of the two systems follows.

Thoroughfare Classification Systems

Streets perform two primary functions, traffic service and land access, which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely developed abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets that permits travel from origins to destinations with directness, ease and safety. Different streets in this system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict.

Urban Classification

In the urban thoroughfare plan, such as the Town of Robbinsville, elements are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares

These routes are the primary traffic arteries of the urban area and they accommodate traffic movements within, around, and through the area.

Minor Thoroughfares

Roadways classified under this under this type collect traffic from the local access streets and carry it to the major thoroughfare system.

Local Access Streets

This classification covers streets that have a primary purpose of providing access to the abutting property. This classification may be further classified as either residential, commercial and/or industrial depending upon the type of land use that they serve.

Idealized Major Thoroughfare System

The coordinated system of major thoroughfares that is most adaptable to the desired lines of travel within an urban area and that is reflected in most urban area thoroughfare plans is the radial-loop system. The radial-loop system includes radials, crosstowns, loops, and bypasses (Figure A-1).

Radial streets provide for traffic movement between points located on the outskirts of the city and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district depends upon the adequacy of this type of thoroughfare.

If all radial streets crossed in the central area, an intolerable congestion problem would result. To avoid this problem, it is very important to have a system of crosstown streets that form a loop around the central business district. This system allows traffic moving from origins on one side of the central area to destinations on the other side to follow the area's border. It also allows central area traffic to circle and then enter the area near a given destination. The effect of a good crosstown system is to free the central area of crosstown traffic, thus permitting the central area to function more adequately in its role as a business or pedestrian shopping area.

Loop system streets move traffic between suburban areas of the city. Although a loop may completely encircle the city, a typical trip may be from an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets do not necessarily carry heavy volumes of traffic, but they function to help relieve central areas. There may be one or more loops, depending on the size of the urban area. They are generally spaced one-half mile to one mile apart, depending on the intensity of land use.

A bypass is designed to carry traffic through or around the urban area, thus providing relief to the city street system by removing traffic that has no desire to be in the city. Bypasses are usually designed to through-highway standards, with control of access. Occasionally, a bypass with low traffic volume can be designed to function as a portion of an urban loop. The general effect of

bypasses is to expedite the movement of through traffic and to improve traffic conditions within the city. By freeing the local streets for use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area.

Rural Classification

The facilities outside the urban thoroughfare planning boundaries make up the rural system. There are four major systems: principal arterials, minor arterials, major and minor collectors, and local roads.

Rural Principal Arterial System

This system is a connected network of continuous routes that serve corridor movements having substantial statewide or interstate travel characteristics. This will be shown by both the trip lengths and the travel densities. The principal arterial system should serve all urban areas of over 50,000 population and most of those with a population greater than 5,000. The Interstate system constitutes a significant portion of the principal arterial system.

Rural Minor Arterial System

This system forms a network that links cities, larger towns, and other traffic generators such as large resorts. The minor arterial system generally serves intrastate and intercounty travel and travel corridors with trip lengths and travel densities somewhat less than the principal arterial system.

Rural Collector Road System

The rural collector routes generally serve intracounty travel. These routes serve travel whose distances are shorter than on the arterial routes. The rural collector road system is subclassified into major and minor collector roads.

- **Major Collector Roads** - These routes provide service to the larger towns not directly served by the higher systems and to other traffic generators of equivalent intracounty importance, such as consolidated schools, shipping points, county parks, significant mining and agricultural areas, etc. Major collector roads also link these places to routes of higher classification and serve the more important intracounty travel corridors.
- **Minor Collector Roads** - These routes collect traffic from local roads and bring all developed areas within a reasonable distance of a major collector road. They also provide service to the remaining smaller communities and link the locally important traffic generators with the rural outskirts.

Rural Local Road System

The local roads are all roads that are not on a higher system. Local residential subdivision streets and residential collector streets are elements of the local road system. Local residential streets are either cul-de-sacs, loop streets less than 762 m (2,500 ft) in length, or streets less than 1.6 km (1 mi) in length. They do not connect thoroughfares or serve major traffic generators and do not collect traffic from more than one hundred dwelling units. Residential collectors serve as the connecting street system between local residential streets and the thoroughfare system.

Figure A-2 gives the schematic illustration of a functionally classified rural highway system. The functional classification for Graham County is shown in Figure A-3.

Objectives of Thoroughfare Planning

Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system that will meet existing and future travel desires within the urban area. The primary aim of a thoroughfare plan is to guide the development of the urban street system in a manner consistent with the changing traffic patterns. A thoroughfare plan will enable street improvements to be made as traffic demands increase, and it helps eliminate unnecessary improvements, so needless expense can be averted. By developing the urban street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained, requiring a minimum amount of land for street purposes. In addition to providing for traffic needs the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population, commercial and industrial development affect major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

- Other objectives of a thoroughfare plan include:
- To provide for the orderly development of an adequate major street system as land development occurs;
- To reduce travel and transportation costs;
- To reduce the cost of major street improvements to the public through the coordination of the street system with private action;
- To enable private interest to plan their actions, improvements, and development with full knowledge of public intent;
- To minimize disruption and displacement of people and businesses through long range advance planning for major street improvements;
- To reduce environmental impacts, such as air pollution, resulting from transportation, and
- To increase travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency through system coordination and layout.

Operational Efficiency

A street's operational efficiency is improved by increasing the capability of the street to carry more vehicular traffic and people. In terms of vehicular traffic, a street's capacity is defined by the maximum number of vehicles which can pass a given point on a roadway during a given time period under prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, nature of traffic, and weather. Physical ways to improve vehicular capacity include:

- **Street widening** - widening of a street from two to four lanes more than doubles the capacity of the street by providing additional maneuverability for traffic.
- **Intersection improvements** - increasing the turning radii, adding exclusive turn lanes, and channelizing movements can improve the capacity of an existing intersection.
- **Improving vertical and horizontal alignment** - reduces the congestion caused by slow moving vehicles.
- **Eliminating roadside obstacles** - reduces side friction and improves a driver's field of sight.

Operational ways to improve street capacity include:

- **Control of Access** - a roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane width and number.
- **Parking removal** - Increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking and unparking vehicles.
- **One-way operation** - The capacity of a street can sometimes be increased 20 -50%, depending upon turning movements and overall street width, by initiating one-way traffic operations. One-way streets can also improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.
- **Reversible lane** - Reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods.
- **Signal phasing and coordination** - Uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

- **Carpools** - Encourage people to form carpools and vanpools for journeys to work and other trip purposes. This reduces the number of vehicles on the roadway and raises the people carrying capability of the street system.
- **Alternate mode** - Encourage the use of transit and bicycle modes.
- **Work hours** - Encourage industries, businesses, and institutions to stagger work hours or establish variable work hours for employees. This will spread peak travel over a longer time period and thus reduce peak hour demand.

- **Land use** - Plan and encourage land use development or redevelopment in a more travel efficient manner.

System Efficiency

Another means for altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost to the user. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

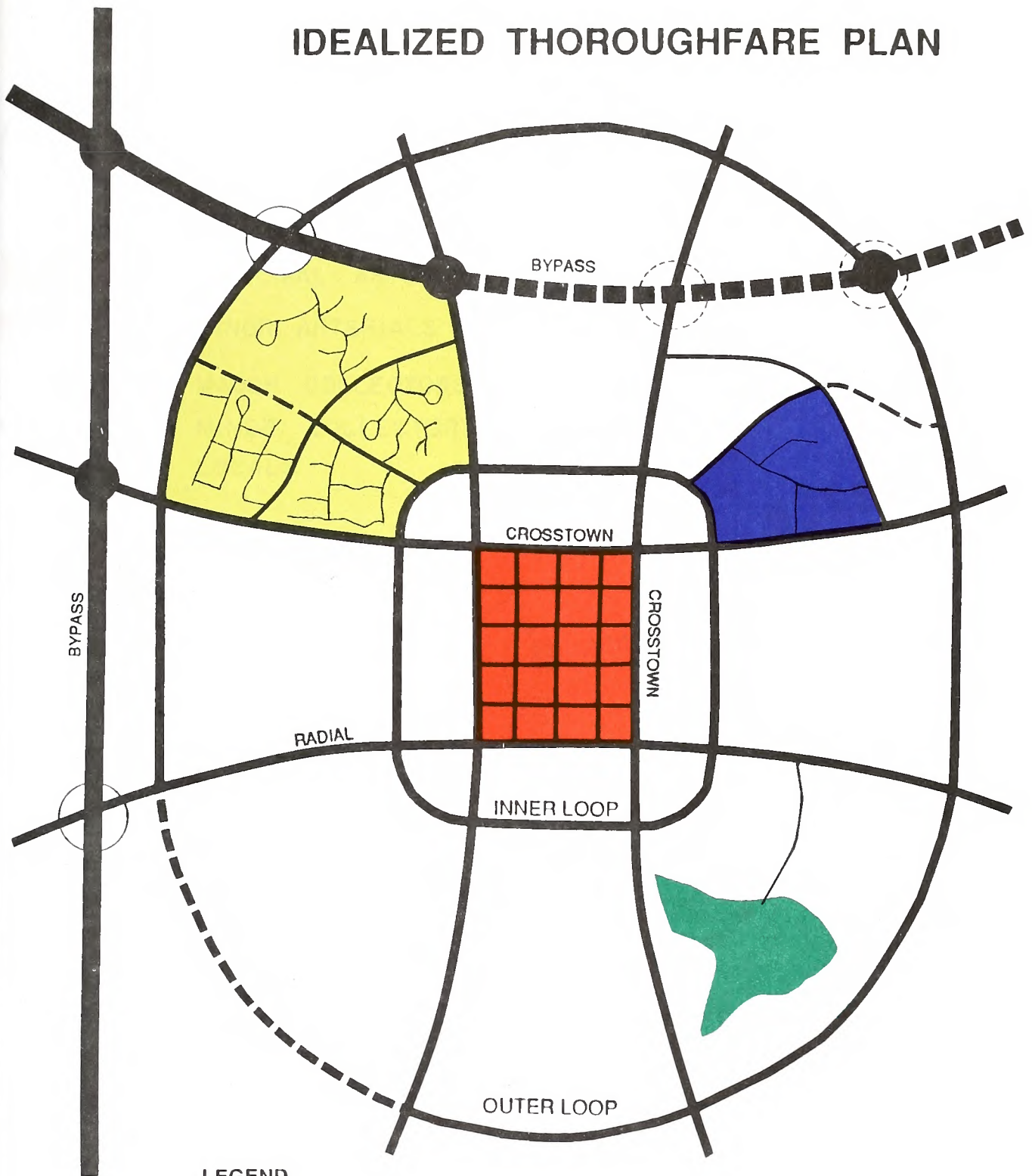
Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system efficiency, functional classification, and idealized major thoroughfare system are the conceptual tools available to the transportation planner in developing a thoroughfare plan. In actual practice thoroughfare planning is done for established urban area and is constrained by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect major street locations.

Through the thoroughfare planning process it is necessary from a practical viewpoint that certain basic principles be followed as closely as possible. These principles are listed below:

1. The plan should be derived from a thorough knowledge of today's travel - its component parts, and the factors that contribute to it, limit it, and modify it.
2. Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of major traffic movements on a few streets.
3. The plan should conform to and provide for the land development plan for the area.
4. Certain considerations must be given to urban development beyond the current planning period. Particularly in outlying or sparsely developed areas that have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights-of-way for future thoroughfare development.
5. While being consistent with the above principles and realistic in terms of travel trends, the plan must be economically feasible.

IDEALIZED THOROUGHFARE PLAN



LEGEND

EXISTING

PROPOSED

LAND USES

MAJOR THOROUGHFARE
FREEWAY

MAJOR OTHER

MINOR THOROUGHFARE

LOCAL ROAD

INTERCHANGE

GRADE SEPERATION

COMMERCIAL/BUSINESS

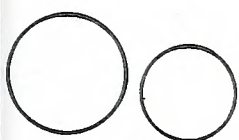
RESIDENTIAL

INDUSTRIAL

PUBLIC/INSTITUTIONAL

FIGURE A-1

LEGEND



CITIES AND TOWNS

VILLAGE



PRINCIPAL ARTERIALS



MINOR ARTERIALS



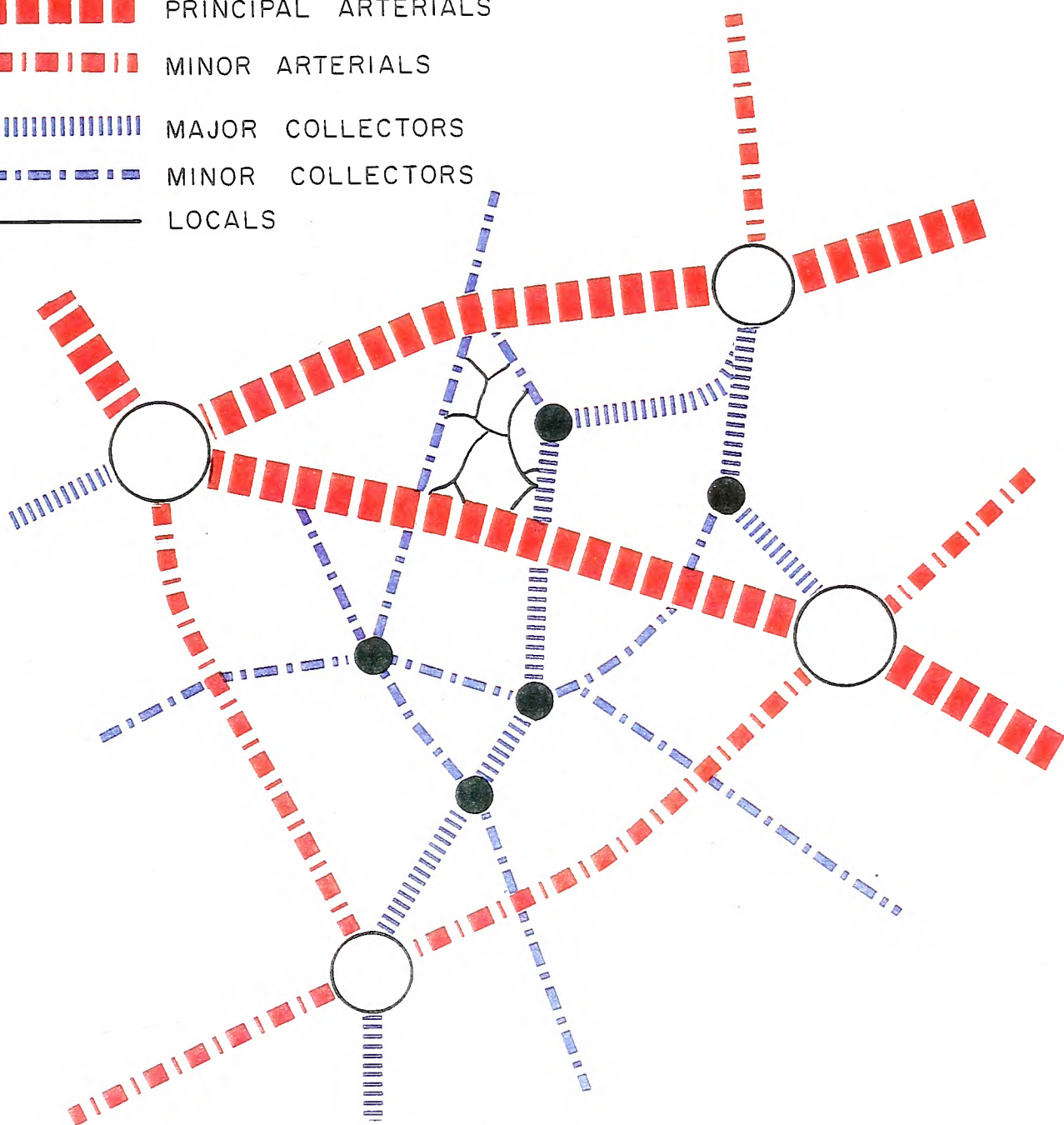
MAJOR COLLECTORS



MINOR COLLECTORS



LOCALS



SCHEMATIC ILLUSTRATION
OF FUNCTIONALLY CLASSIFIED
RURAL HIGHWAY NETWORK

GRAHAM COUNTY FUNCTIONAL CLASSIFICATION

LEGEND

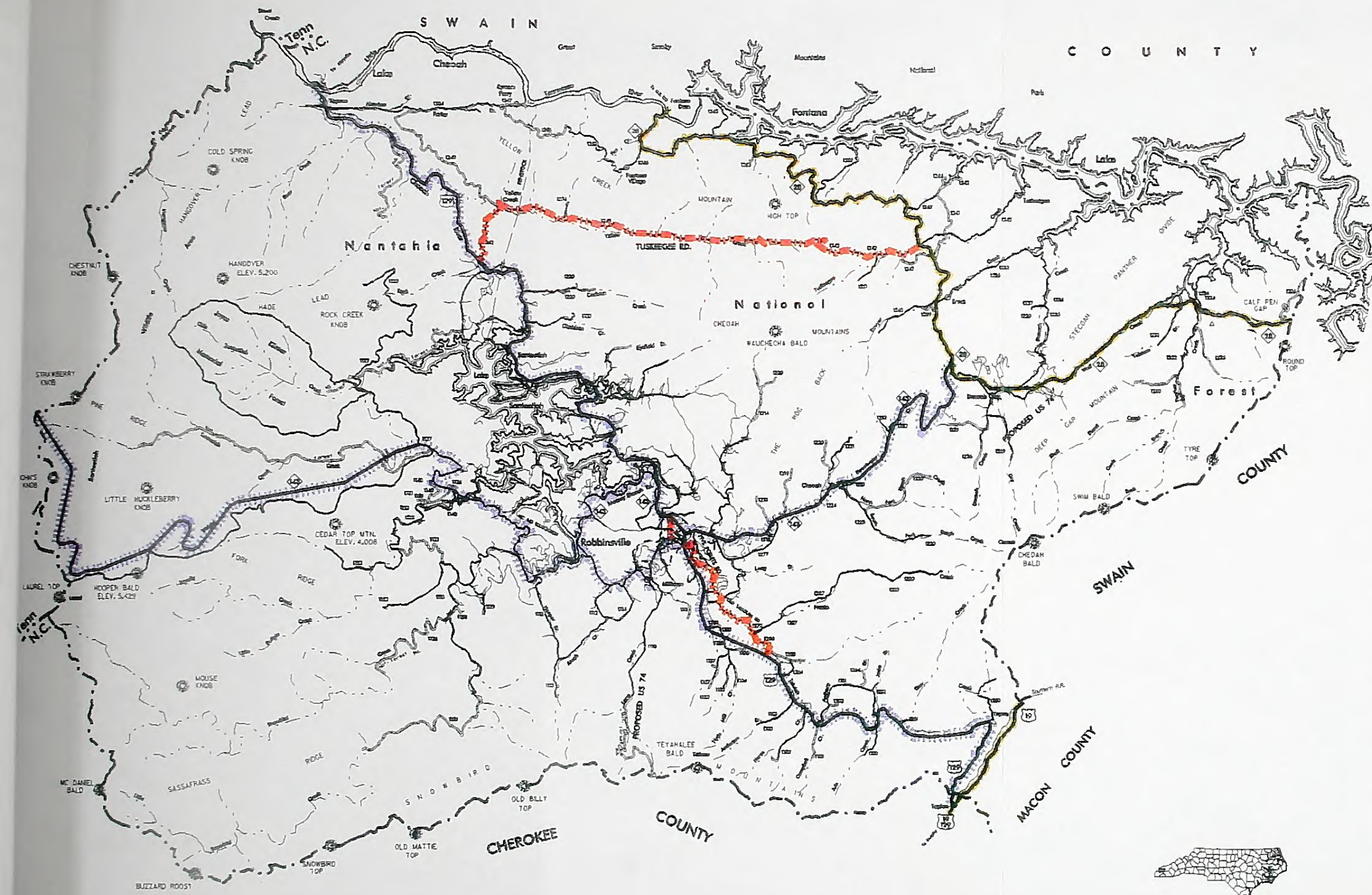
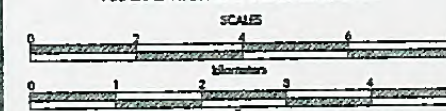
	EXISTING
MINOR ARTERIAL	
MAJOR COLLECTOR	
MINOR COLLECTOR	

FIGURE A-3



GRAHAM COUNTY NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION



Appendix B

THOROUGHFARE STREET TABULATION AND RECOMMENDATIONS

This appendix includes a detailed tabulation of all streets identified as elements of the Graham County Thoroughfare Plan (pages 67 - 69) and the Town of Robbinsville Thoroughfare Plan (pages 70 -72). The tables include a description of each section, as well as the length, cross section, and right-of-way for each section. Also included are existing and projected average daily traffic volumes, roadway capacity, and the recommended ultimate lane configuration. Due to space constraints, these recommended cross sections are given in the form of an alphabetic code. A detailed description of each of these codes and a illustrative figure for each can be found in Appendix C.

The following index of terms may be helpful in interpreting the table:

NCL - Northern Corporate Limits

SCL - Southern Corporate Limits

ECL - Eastern Corporate Limits

NPB - Northern Planning Boundary

SPB - Southern Planning Boundary

EPB - Eastern Planning Boundary

WPB - Western Planning Boundary

SR - State Road

N/A - Not Available

Appendix B

Graham County Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	EXISTING CROSS SECTION							PRACTICAL CAPACITY CURRENT (FUTURE)	1996 AADT	2025 AADT	RECOMMENDED	
	S. I. UNITS			ENGLISH UNITS			NUMBER OF LANES				RDWY (ULT)	ROW (ULT)
	DIST km	RDWY m	ROW m	DIST MI	RDWY FT	ROW FT						
US 74 Relocation												
Swain Co. - SR 1231	3.71	6.7	45.7	2.30	22	150	2	4,900	1,700	6,000		
							(4)	(30,000)			F	100
SR 1231 - NC 28	5.00	6.7	45.7	3.10	22	150	2	4,900	1,200	6,000		
							(4)	(30,000)			F	100
NC 28 - NC 143	(6.19)			(3.84)			(4)	(30,000)	n/a	4,200	A	100
Former NC 143 Wide	4.18	7.3	30.5	2.59	24	100	2	5,500	2,300	6,900		
							(4)	(38,000)			F	100
NC 143 - EPB Robb.	(0.61)			(0.38)			(4)	(38,000)	n/a	3,900	A	100
EPB Robb.- Cherokee	(see Robbinsville Thoroughfare Plan)											
US 129												
Cherokee - Topton	2.90	6.1	30.5	1.80	20	100	2	4,700	2,300	3,800	ADQ	ADQ
Topton - SR 1204	3.22	6.7	30.5	5.20	22	100	2	5,200	2,400	4,200	ADQ	ADQ
SR 1204 - SPB Robb.	2.90	6.7	30.5	1.80	22	100	2	5,200	2,800	6,000	ADQ	ADQ
SPB Robb.-NPB Robb.	(see Robbinsville Thoroughfare Plan)											
NPB Robb. - SR 1254	2.69	6.7	30.5	1.67	22	100	2	5,200	1,900	3,400	ADQ	ADQ
SR 1254 - SR 1250	7.26	6.7	30.5	4.50	22	100	2	5,200	1,000	1,800	ADQ	ADQ
SR 1250 - Topoco	10.97	6.7	18.3	6.80	22	60	2	4,700	370	1,000	ADQ	ADQ
Topoco - Swain Co.	0.61	6.7	18.3	0.38	22	60	2	4,700	300	800	ADQ	ADQ
NC 28												
Swain Co. - US 74 Rel.	(Common to US 74 Relocation)											
US 74 Rel.- NC 143	2.26	6.7	45.7	1.40	22	150	2	4,900	2,200	1,700	ADQ	ADQ
NC 143 - SR 1245	16.39	6.7	45.7	10.16	22	150	2	4,900	880	1,400		
							(2)	(6,000)			ADQ	ADQ
SR 1245 - Swain Co.N	4.68	6.1	30.5	2.90	20	100	2	4,400	350	1,000		
							(2)	(6,000)			ADQ	ADQ
NC 143 (Cherohala Skyway)												
Cherohala Skyway	28.68	6.7	n/a	17.91	22	n/a	2	6,000	1,700	5,000	ADQ	ADQ

Appendix B

Graham County Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	EXISTING CROSS SECTION						NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1996 AADT	2025 AADT	RECOMMENDED		
	S. I. UNITS			ENGLISH UNITS							X - SECTION	RDWY (ULT)	ROW (ULT)
	DIST km	RDWY m	ROW m	DIST MI	RDWY FT	ROW FT							
NC 143 (Snowbird Road)													
Cherohala - Relocation	1.39	6.1	n/a	0.80	20	n/a	2	5,000	650*	4,500			
							(2)	(6,000)			K	60	
Relocation - Lake San.	3.22	6.1	n/a	2.00	20	n/a	2	5,000	650*	300	ADQ	ADQ	
Lake San. - Relocation	2.74	5.5	n/a	1.70	18	n/a	2	4,500	1200*	4,500			
							(2)	(6,000)			K	60	
Relocation-WPB Robb.	3.45	5.5	n/a	2.14	18	n/a	2	4,500	1200*	1,100	ADQ	ADQ	
WPB Robb - NC 143B	(see Robbinsville Thoroughfare Plan)												
NC 143 (Massey Branch Road)													
NC 143 Bus - US 129	(see Robbinsville Thoroughfare Plan)												
NC 143 (Tallulah Road)													
US 129 - US 129	(see Robbinsville Thoroughfare Plan)												
NC 143 (Sweetwater Road)													
US 129 - EPB Robb.	(see Robbinsville Thoroughfare Plan)												
EPB Robb.-US 74 Rel.	0.94	7.3	30.5	0.58	24	100	2	5,500	2,300	3,000	ADQ	ADQ	
US 74 Relocation	(Common to US 74 Relocation)												
US 74 Rel. - US 28	6.77	7.3	30.5	4.20	24	100	2	5,500	1,900	2,700	ADQ	ADQ	
NC 143 Relocation													
NC 143 - Lake Sant.	(1.29)			(0.80)			(2)	(6,000)	n/a	4,000	K	100	
Lake Sant. - Relocation	(Common to NC 143)												
Relocation-WPB Robb.	(1.13)			(0.70)			(2)	(6,000)	n/a	4,000	K	100	
WPB Robb.-NC 143 B	(see Robbinsville Thoroughfare Plan)												
NC 143 Business (Main Street)													
US 129N - SR 1127	(see Robbinsville Thoroughfare Plan)												
NC 143 Business (Junaluska Road)													
Masonic St.-Atoah St.	(see Robbinsville Thoroughfare Plan)												
NC 143 Business (Snowbird Road)													
Atoah St. - NC 143	(see Robbinsville Thoroughfare Plan)												

Appendix B

Graham County Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	EXISTING CROSS SECTION							PRACTICAL CAPACITY CURRENT (FUTURE)	1996 AADT	2025 AADT	RECOMMENDED X - SECTION	
	S. I. UNITS			ENGLISH UNITS			NUMBER OF LANES				RDWY (ULT)	ROW (ULT)
	DIST km	RDWY m	ROW m	DIST MI	RDWY FT	ROW FT						
SR 1206 (Old Tallulah Road)												
SR 1275 - SPB Robb.	(see Robbinsville Thoroughfare Plan)											
SPB Robb.- US 129	2.56	5.2	n/a	1.59	17	n/a	2	4,800	300	400	18'	60
SR 1242 (Tuskegee Road)												
US 129 - SR 1274	6.77	4.9	n/a	4.20	16	n/a	2	3,500	240	350	18'	60
SR 1274 - NC 28	13.39	5.5	18.3	8.30	18	60	2	5,500	400	550	ADQ	ADQ
SR 1275 (Five Points Road)												
US 129 - NC 143	(see Robbinsville Thoroughfare Plan)											

Appendix B

Robbinsville Thoroughfare Plan

Street Tabulation and Recommendations

FACILITY & SECTION	EXISTING CROSS SECTION						NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1996 AADT	2025 AADT	RECOMMENDED X - SECTION	
	S. I. UNITS			ENGLISH UNITS							RDWY (ULT)	ROW (ULT)
	DIST km	RDWY m	ROW m	DIST MI	RDWY FT	ROW FT						
US 74 Relocation												
Swain Co. - EPB Robb.	(see Graham County Thoroughfare Plan)											
EPB Robb. - US 129	(3.13)			(1.94)			(4)	(38,000)	n/a	3,900	A	100
US 29 - Cherokee Cty	(see Graham County Thoroughfare Plan)											
US 129												
Cherokee - SPB Robb.	(see Graham County Thoroughfare Plan)											
SPB - SR 1260	1.13	6.7	30.5	0.70	22	100	2	5,200	4,100	9,400		
							(2)	7,500			K	ADQ
SR 1260 - SCL Robb.	1.74	6.7	30.5	1.08	22	100	3	11,000	8,000	14100	ADQ	ADQ
SCL Robb. - NC 143S.	0.37	9.2	n/a	0.23	30	n/a	3	14,000	9,600	18700		ADQ
							(5)	(30,000)			C	ADQ
NC 143S-NC 143 Bus.	0.76	9.2	n/a	0.47	30	n/a	3	14,000	3,800	8,000		
							(5)	(30,000)			C	ADQ
NC 143 Bus -NCL Rob	0.29	6.7	30.5	0.18	22	100	2	5,200	3,800	8,000		ADQ
							(2)	(7,500)			K	
NCL Robb. - NC 143N	1.23	6.7	30.5	0.76	22	100	2	5,200	3,800	8,000		70
							(2)	(7,500)			K	
NC 143N - NPB Robb	2.13	6.7	30.5	1.33	22	100	2	5,200	1,900	3,400	ADQ	70
NPB Robb - Swain Co.	(see Graham County Thoroughfare Plan)											
NC 143 (Snowbird Road)												
Cherohala- WPB Robb	(see Graham County Thoroughfare Plan)											
WPB Robb. - US 143B	4.52	5.5	n/a	2.80	18	n/a	2	4,500	1200*	1,100	ADQ	ADQ
NC 143 (Massey Branch Road)												
NC 143 Bus - US 129	5.97	6.1	21.3	3.70	20	70	2	5,000	1400*	4,800		
							(2)	(6,000)			K	ADQ
NC 143 (Tallulah Road)												
US 129 - US 129	(Common to US 129)											
NC 143 (Sweetwater Road)												
US 129 - ECL Robbin.	0.24	7.3	30.5	0.15	24	100	2	9,000	3,600	6,800	ADQ	ADQ
ECL Robb.-EPB Robb.	2.15	7.3	30.5	1.33	24	100	2	5,500	2,300	3,000	ADQ	ADQ
EPB Robb - US 28	(see Graham County Thoroughfare Plan)											

Appendix B

Robbinsville Thoroughfare Plan Street Tabulation and Recommendations

FACILITY & SECTION	EXISTING CROSS SECTION						PRACTICAL CAPACITY CURRENT (FUTURE)	1996 AADT	2025 AADT	RECOMMENDED X - SECTION		
	S. I. UNITS			ENGLISH UNITS						NUMBER OF LANES	RDWY (ULT)	ROW (ULT)
	DIST km	RDWY m	ROW m	DIST MI	RDWY FT	ROW FT						
NC 143 Relocation												
NC 143 - WPB Robb.	(see Graham County Thoroughfare Plan)											
WPB Robb.- NC 143B	(0.97)			(0.60)			(2)	(6,000)	n/a	4,000	K	100
NC 143 Business (Main Street)												
US 129N - Width Chg	0.26	7.3	n/a	0.16	24	n/a	2	11,000	3,000	5,600	ADQ	ADQ
Width Chg - SR 1127	0.42	var	n/a	0.26	var	n/a	2	11,000	3,000	3,500	ADQ	ADQ
NC 143 Business (Junaluska Road)												
Masonic St.-Atoah St.	0.24	6.1	n/a	0.15	20	n/a	2	5,500	3,100	4,200	ADQ	60
NC 143 Business (Snowbird Road)												
Atoah St. - SCL Robb.	0.44	6.1	n/a	0.27	20	n/a	2	6,500	3,100	6,300	ADQ	ADQ
SCL Robb. - NC 143	4.27	5.5	n/a	2.65	18	n/a	2	5,000	2,700	5,100		
							(2)	(6,000)			K	60
SR 1106 (N. Main Street)												
US 129N - Courthouse	(Now signed NC 143 Business)											
SR 1106 (S. Main Street)												
US 129 - NC 143B	0.29	7.3	n/a	0.18	24	n/a	2	8,000	2,800	5,000	ADQ	ADQ
SR 1116 (Massey Branch Road)												
US 129N - NC 143 Bus	(Now signed NC 143)											
SR 1127 (Snowbird Road)												
SR 1106 - NC 143	(Now signed NC 143 Business)											
NC 143B - Cherohala	(Now signed NC 143)											
SR 1206 (Old Tallulah Road)												
SR 1275 - SR 1260	2.05	4.3	n/a	1.27	14	n/a	2	3,000	250	350	18'	60
SR 1260 - SR1208	0.26	5.5	n/a	0.16	18	n/a	2	5,500	1,100	1,500	20'	60
SR 1208 - SPB Robb.	0.61	5.2	n/a	0.38	17	n/a	2	4,800	300	400	18'	60
SPB Robb -US 129	(see Graham County Thoroughfare Plan)											

Appendix B

Robbinsville Thoroughfare Plan

Street Tabulation and Recommendations

FACILITY & SECTION	EXISTING CROSS SECTION							PRACTICAL CAPACITY CURRENT (FUTURE)	1996 AADT	2025 AADT	RECOMMENDED X - SECTION	
	S. I. UNITS			ENGLISH UNITS			NUMBER OF LANES					
	DIST km	RDWY m	ROW m	DIST MI	RDWY FT	ROW FT						
SR 1275 (Five Points Road)												
US 129 - ECL Robb.	0.05	7.3	n/a	0.03	24	n/a	2	11,000	2,000	2,700	ADQ	60
ECL Robb. - SR 1269	0.32	6.1	n/a	0.20	20	n/a	2	5,600	1,100	1,500	ADQ	60
SR 1269 - NC 143	0.48	6.1	n/a	0.30	20	n/a	2	4,700	400	550	ADQ	60
Atoah Street												
NC 143B - Cody Street	0.40	6.1	n/a	0.25	20	n/a	2	6,000	n/a	2,100	ADQ	ADQ
Atoah St. Extension												
SR 1117 - Cody Street	0.39	7.3	18.3	0.24	24	60	(2)	(6,500)	n/a	2,100	K	60
Ford Street												
US 129 - NC 143 Bus.	0.55	6.1	n/a	0.34	20	n/a	2	6,000	n/a	500	ADQ	ADQ

Appendix C

TYPICAL CROSS SECTIONS

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its cross section requirements determined on the basis of amount and type of projected traffic, existing capacity, desired level of service, and available right-of-way. Typical cross section recommendations are shown in Figure C-1. These cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

The recommended typical cross sections shown in Appendix B, Table B-1 were derived on the basis of projected traffic, existing capacities, desirable levels of service, and available right-of-way.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, adequate right-of-way should be protected or acquired for the ultimate cross sections. Ultimate desirable cross sections for each of the thoroughfares are listed in Appendix B. Recommendations for “ultimate” cross sections are provided for the following:

1. thoroughfares which may require widening after the current planning period
2. thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient
3. thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment.

Recommended design standards relating to grades, sight distances, degree of curve, super elevation, and other considerations for thoroughfares are given in Appendix D.

A - Four Lanes Divided with Median - Freeway

Typical for four lane divided highways in rural areas which may have only partial or no control of access. The minimum median width for this cross section is 14 m (46 ft), but a wider median is desirable.

B - Seven Lanes - Curb & Gutter

This cross section is not recommended for new projects. When the conditions warrant six lanes, cross section “D” should be recommended. Cross section “B” should be used only in special situations such as when widening from a five lane section and right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section “D” is the final cross section.

C - Five Lanes - Curb & Gutter

Typical for major thoroughfares, this cross section is desirable where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

D - Six Lanes Divided with Raised Median - Curb & Gutter **E - Four Lanes Divided with Raised Median - Curb and Gutter**

These cross sections are typically used on major thoroughfares where left turns and intersection streets are not as frequent. Left turns would be restricted to a few selected intersections. The 4.8 m (16 ft) median is the minimum recommended for an urban boulevard type cross section. In most instances, monolithic construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians result in greatly increased maintenance costs and an increase in danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

F - Four Lanes Divided - Boulevard, Grass Median

Recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 7.3 m (24 ft) is recommended with 9.1 m (30 ft) being desirable.

G - Four Lanes - Curb & Gutter

This cross section is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would probably be required at major intersections. This cross section should be used only if the above criteria are met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

H - Three Lanes - Curb & Gutter

In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require cross section "H".

I - Two Lanes - C&G, Parking both sides **J - Two Lanes - C&G, Parking one side**

Cross section "I" and "J" are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "I" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

K - Two Lanes - Paved Shoulder

This cross section is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 30 m (100 ft) should be required. In some instances, local ordinances may not allow the full 30 m. In those cases, 21 m (70 ft) should be preserved with the understanding that the full 30 m will be preserved by use of building setbacks and future street line ordinances.

L - Six Lanes Divided with Grass Median - Freeway

Cross section “L” is typical for controlled access freeways. The 14 m (46 ft) grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 70 m (228 ft) depending upon cut and fill requirements.

M - Eight Lanes Divided with Raised Median - Curb & Gutter

Also used for controlled access freeways, this cross section may be recommended for freeways going through major urban areas or for routes projected to carry very high volumes of traffic.

N - Five Lanes/C&G, Widened Curb Lanes

O - Two Lane/Shoulder Section

P - Four Lanes Divided/Raised Median, C&G, Widened Curb Lanes

If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. Cross sections “N”, “O”, and “P” are typically used to accommodate bicycle travel.

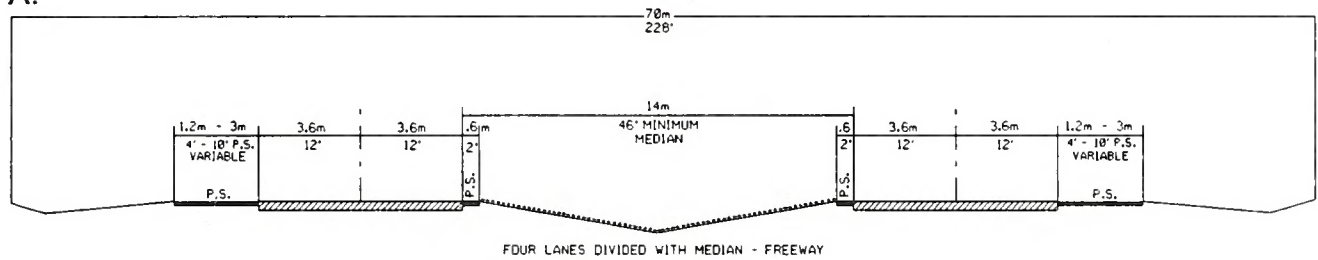
General

The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

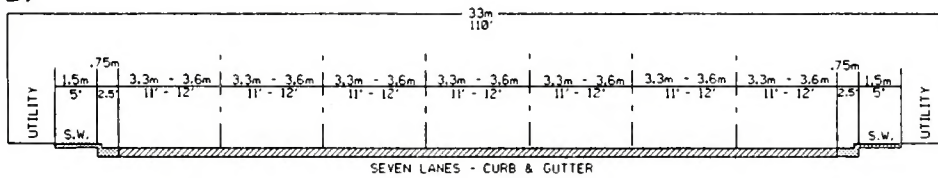
The right-of-ways shown for the typical cross sections are the minimum right-of-way required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

TYPICAL THOROUGHFARE CROSS SECTIONS

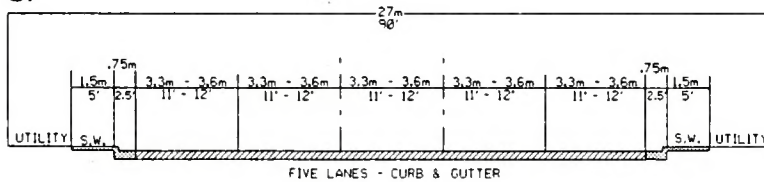
A.



B.



C.



D.

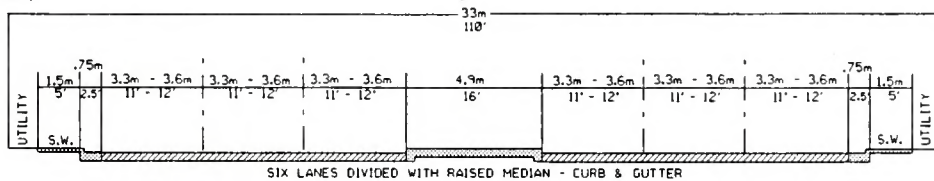
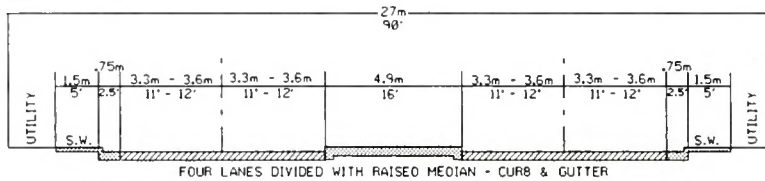


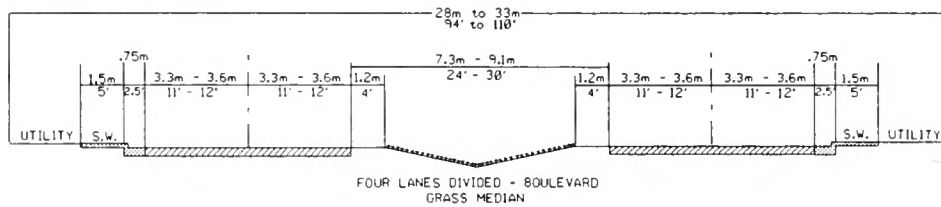
FIGURE C-1

TYPICAL THOROUGHFARE CROSS SECTIONS

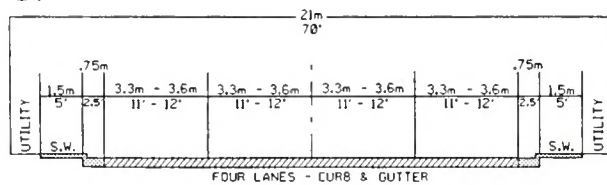
E.



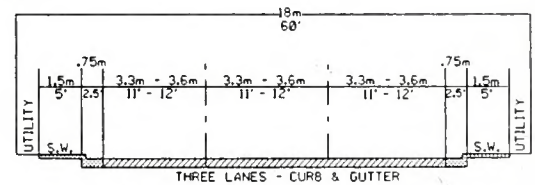
F.



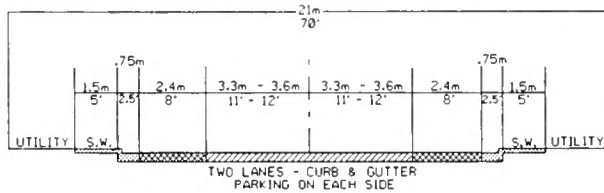
G.



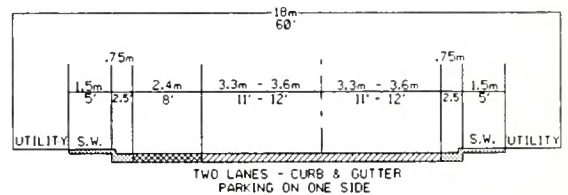
H.



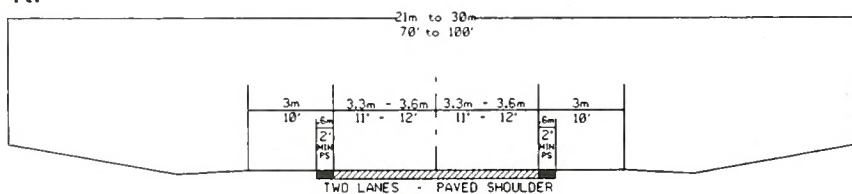
I.



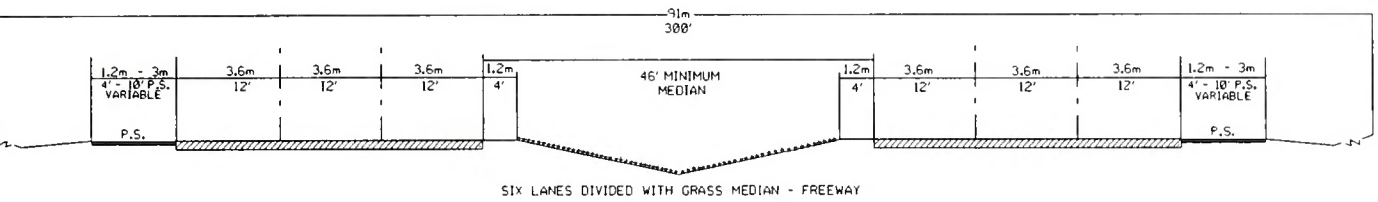
J.



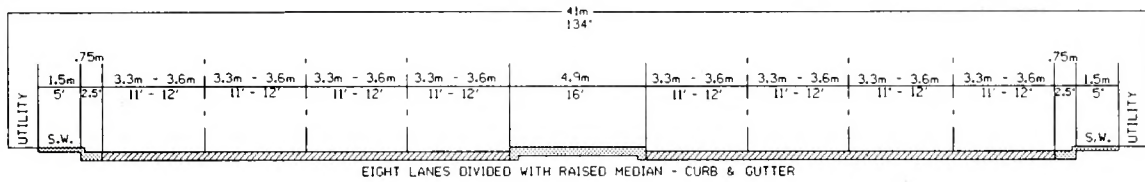
K.



TYPICAL THOROUGHFARE CROSS SECTIONS

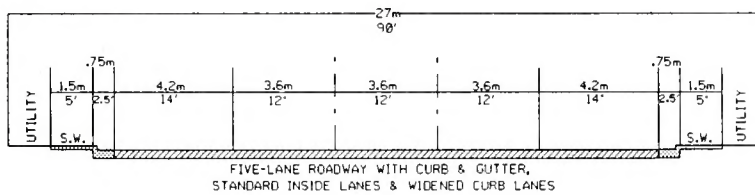


M.

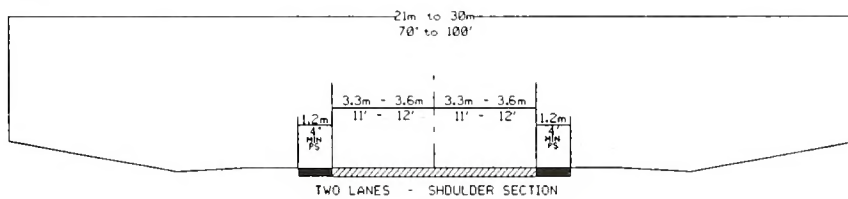


TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



O.



P.

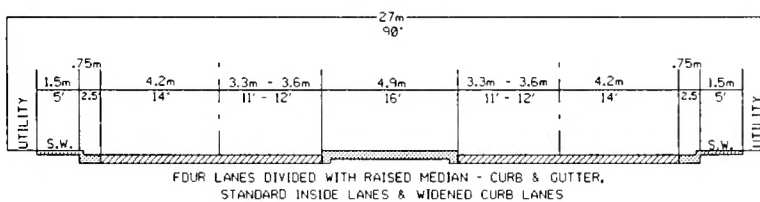


FIGURE C-1

Appendix D

RECOMMENDED SUBDIVISION ORDINANCES

Definitions

Streets and Roads

Rural Roads

- **Principal Arterial** - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.
- **Minor Arterial** - A rural roadway joining cities and larger towns and providing intra-state and inter-county service at relatively high overall travel speeds with minimum interference to through movement.
- **Major Collector** - A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.
- **Minor Collector** - A road which provides service to small local communities and traffic generators and provides access to the Major Collector system.
- **Local Road** - A road which serves primarily to provide access to adjacent land, over relatively short distances.

Urban Streets

- **Major Thoroughfares** - Major thoroughfares consist of Inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.
- **Minor Thoroughfares** - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.
- **Local Street** - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

Specific Type Rural or Urban Streets

- **Freeway, expressway, or parkway** - Divided multilane roadways designed to carry large volumes of traffic at high speeds. A *freeway* provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An *expressway* is a facility with full or partial control of access and generally with grade separations at major intersections. A *parkway* is for non-commercial traffic, with full or partial control of access.
- **Residential Collector Street** - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.
- **Local Residential Street** - Cul-de-sacs, loop streets less than 760 m (2500 ft) in length, or streets less than 1.6 km (1.0 mi) in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.
- **Cul-de-sac** - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.
- **Frontage Road** - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.
- **Alley** - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

Property

Building Setback Line

A line parallel to the street in front of which no structure shall be erected.

Easement

A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

Lot

A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

Subdivision

Subdivider

Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.

Subdivision

All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets.

The following shall not be included within this definition nor subject to these regulations.

- The combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein
- the division of land into parcels greater than 4 hectares (10 acres) where no street right-of-way dedication is involved
- the public acquisition, by purchase, of strips of land for the widening or the opening of streets
- the division of a tract in single ownership whose entire area is no greater than 0.8 hectares (2 acres) into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

Dedication

A gift, by the owner, of his property to another party without any consideration being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.

Reservation

Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

Design Standards

Streets and Roads

The design of all roads within the Planning Area shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted by the municipality. The proposed street layout shall be

coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

Right-of-way Widths

Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where (ROW) requirements have been specifically set out in the Thoroughfare Plan.

The subdivider will only be required to dedicate a maximum of 30 m (100 ft) of right-of-way. In cases where over 30 m (100 ft) of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 30 m (100 ft). On all cases in which right-of-way is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width right-of-way, not less than 18 m (60 ft) in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is sub-divided, the remainder of the full required right-of-way shall be dedicated.

Table D-1

Minimum Right-of-way Requirements		
Area Classification	Functional Classification	Minimum ROW
RURAL	Principle Arterial	Freeways- 105 m (350 ft) Other- 60 m (200 ft)
	Minor Arterial	30 m (100 ft)
	Major Collector	30 m (100 ft)
	Minor Collector	24 m (80 ft)
	Local Road	18 m ¹ (60 ft)
URBAN	Major Thoroughfare	27 m (90 ft)
	Minor Thoroughfare	21 m (70 ft)
	Local Street	18 m ¹ (60 ft)
	Cul-de-sac	variable ²

¹The desirable minimum right-of-way (ROW) is 18 m (60 ft). If curb and gutter is provided, 15 m (50 ft) of ROW is adequate on local residential streets.

²The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.

Street Widths

Widths for street and road classifications other than local shall be as recommended by the Thoroughfare Plan. Width of local roads and streets shall be as follows:

- **Local Residential**
 - Curb and Gutter section - 7.8 meters (26 ft), face to face curb
 - Shoulder section - 6.0 meters (20 ft) to edge of pavement, 1.2 meters (4 ft) for shoulders
- **Residential Collector**
 - Curb and Gutter section - 10.2 meters (34 ft), face to face of curb
 - Shoulder section - 6.0 meters (20 ft) to edge of pavement, 1.8 meters (6 ft) for shoulders

Geometric Characteristics

The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-way shall apply.

- **Design Speed** - The design speed for a roadway should be a minimum of 10 km/h (5 mph) greater than the posted speed limit. The design speeds for subdivision type streets are shown in Tables D-2 (metric) and D-3 (english).
- **Minimum Sight Distance** - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provide and calculated using the parameters set forth in Tables D-4 (metric) and D-5 (english).
- **Superelevation** - Tables D-6 (metric) and D-7 (english) show the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.
- **Maximum and Minimum Grades**
 - the maximum grades in percent are shown in Table D-8 (metric) and D-9 (english)
 - minimum grade should not be less then 0.5%
 - grades for 30 meters (100 ft) each way from intersections (measured from edge of pavement) should not exceed 5%

Table D-2

Facility Type	Design Speeds (Metric)		
	Desirable	Design Speed (km/h)	
		Level	Minimum Rolling
RURAL			
Minor Collector Roads (ADT Over 2000)	100	80	60
Local Roads ¹ (ADT Over 400)	80	80	60
URBAN			
Major Thoroughfares ²	100	60	60
Minor Thoroughfares	100	50	50
Local Streets	50	50	30

¹Local Roads including Residential Collectors and Local Residential.

²Major Thoroughfares other than Freeways or Expressways.

Table D-3

Facility Type	Design Speeds (English)		
	Desirable	Design Speed (mph)	
		Level	Minimum Rolling
RURAL			
Minor Collector Roads (ADT Over 2000)	60	50	40
Local Roads ¹ (ADT Over 400)	50	*50	*40
URBAN			
Major Thoroughfares ²	60	50	40
Minor Thoroughfares	40	30	30
Local Streets	30	**30	**20

Note: *Based on ADT of 400-750. Where roads serve a limited area and small number of units, can reduce minimum design speed. **Based on projected ADT of 50-250. (Reference NCDOT Roadway Design Manual page 1-1B)

¹Local Roads including Residential Collectors and Local Residential.

²Major Thoroughfares other than Freeways or Expressways.

Table D-4

Sight Distance (Metric)					
Design Speed Distance (km/h)	Stopping Sight Distance (meters)		Minimum K ¹ Values (meters)		Passing Sight (meters)
	Desirable	Minimum	Crest Curve	Sag Curve	For 2-lanes
30	30	29.6	3	4	*
50	70	57.4	9	11	*
60	90	74.3	14	15	*
90	170	131.2	43	30	*
100	210	157.0	62	37	*

Note: General practice calls for vertical curves to be multiples of 10 meters. Calculated lengths shall be rounded up in each case.

*Minimum passing distance for 2-lanes is currently under revision. (Reference: "NCDOT Roadway Metric Design Manual" page 1-12 T-1)

¹K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length of the vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1990".

Table D-5

Sight Distance (English)					
Design Speed (mph)	Stopping Sight Distance (feet)		Minimum K ¹ Values (feet)		Passing Sight Distance (feet)
	Desirable	Minimum	Crest Curve	Sag Curve	For 2-lanes
30	200	200	30	40	1100
40	325	275	60	60	1500
50	475	400	110	90	1800
60	650	525	190	120	2100

Note: General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case. (Reference: "NCDOT Roadway Design Manual" pg. 1-12 T-1)

¹K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length of the vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1990".

Table D-6

Superelevation Table (Metric)			
Design Speed	Minimum Radius of Maximum e^1		
	$e=0.04$	$e=0.06$	$e=0.08$
50	100	90	80
65	175	160	145
80	280	250	230
100	490	435	395

¹ e = rate of roadway superelevation, meter per meter.

Table D-7

Superelevation Table (English)						
Design Speed (mph)	Minimum Radius of Maximum e^1			Maximum Degree of Curve		
	$e=0.04$	$e=0.06$	$e=0.08$	$e=0.04$	$e=0.06$	$e=0.08$
30	302	273	260	19 00'	21 00'	22 45'
60	573	521	477	10 00'	11 15'	12 15'
80	955	955	819	6 00'	6 45'	7 30'
100	1,637	1,432	1,146	3 45'	4 15'	4 45'

¹ e = rate of roadway superelevation, foot per foot

Note: (Reference: "NCDOT Roadway Design Manual," pg. 1-12 T-6 thru T-8)

Table D-8

Maximum Vertical Grade (Metric)				
Facility Type and Design Speed (km/h)	Minimum Grade in Percent			
	Flat	Rolling	Mountainous	
RURAL				
Minor Collector Roads*				
30	7	10	12	
50	7	9	10	
65	7	8	10	
80	6	7	9	
100	5	6	8	
110	4	5	6	
Local Roads* ¹				
30	-	11	16	
50	7	10	14	
65	7	9	12	
80	6	8	10	
100	5	6	-	
URBAN				
Major Thoroughfares ²				
50	8	9	11	
65	7	8	10	
80	6	7	9	
100	5	6	8	
Minor Thoroughfares*				
30	9	12	14	
50	9	11	12	
65	9	10	12	
80	7	8	10	
100	6	7	9	
110	5	6	7	
Local Streets*				
30	-	11	16	
50	7	10	14	
65	7	9	12	
80	6	8	10	
100	5	6	-	

Note: *For streets and roads with projected annual average daily traffic less than 250 or short grades less than 150 meters (500 ft) long, grades may be 2% steeper than the values in the above table. (Reference NCDOT Roadway Metric Design Manual page 1-12 T-3)

¹Local Roads including Residential Collectors and Local Residential.

²Major Thoroughfares other than Freeways or Expressways.

Table D-9

Maximum Vertical Grade (English)				
Facility Type and Design Speed (km/h)		Minimum Grade in Percent		
		Flat	Rolling	Mountainous
RURAL				
Minor Collector Roads*				
	20	7	10	12
	30	7	9	10
	40	7	8	10
	50	6	7	9
	60	5	6	8
	70	4	5	6
Local Roads* ¹				
	20	-	11	16
	30	7	10	14
	40	7	9	12
	50	6	8	10
	60	5	6	-
URBAN				
Major Thoroughfares ²				
	30	8	9	11
	40	7	8	10
	50	6	7	9
	60	5	6	8
Minor Thoroughfares*				
	20	9	12	14
	30	9	11	12
	40	9	10	12
	50	7	8	10
	60	6	7	9
	70	5	6	7
Local Streets*				
	20	-	11	16
	30	7	10	14
	40	7	9	12
	50	6	8	10
	60	5	6	-

Note: *For streets and roads with projected annual average daily traffic less than 250 or short grades less than 150 meters (500 ft) long, grades may be 2% steeper than the values in the above table. (Reference NCDOT Roadway Metric Design Manual page 1-12 T-3)

¹Local Roads including Residential Collectors and Local Residential.

²Major Thoroughfares other than Freeways or Expressways.

Intersections

Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty-five (65) degrees.

Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

Off-set intersections are to be avoided. Intersections which cannot be aligned should be separated by a minimum length of 60 m (200 ft) between survey centerlines.

Cul-de-sacs

Cul-de-sacs shall not be more than 150 m (500 ft) in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

Alleys

Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provisions are made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.

The width of an alley shall be at least 6.0 m (20 ft).

Dead-end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around facilities at the dead-end as may be required by the Planning Board.

Permits for Connection to State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the Division of Highways.

Offsets To Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 9.0 m (30 ft) from the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 1.8 m (6 ft) from the face of curb.



3 3091 00600 6639

Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

Horizontal Width on Bridge Deck

The clear roadway widths for new and reconstructed bridges serving 2 lane, 2 way traffic should be as follows:

- **Shoulder section approach**

- under 800 ADT design year - minimum 8.4 m (28 ft) width face to face of parapets, rails, or pavement width plus 3 m (10 ft), whichever is greater.
- 800 - 2000 ADT design year - minimum 10.2 m (34 ft) width face to face of parapets, rails, or pavement width plus 3.6 m (12 ft), whichever is greater
- over 2000 ADT design year - minimum width of 12 m (40 ft), desirable width of 3.2 m (44 ft) width face to face of parapets or rails

- **Curb and gutter approach**

- under 800 ADT design year - minimum 7.2 meters (24 ft) face to face of curbs
- over 800 ADT design year - with of approach pavement measured face to face of curbs.

Where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be a minimum of 450 millimeters (1' 6"), or greater if sidewalks are required.

The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

- **Shoulder section approach** - Width of approach pavement plus width of usable shoulders on the approach left and right. (shoulder width 2.4 m (8 ft) minimum, 3 m (10 ft) desirable.)
- **Curb and gutter approach** - Width of approach pavement measured face to face of curbs.

